RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.

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Published on the second day of each month by

Simmons-Boardman Publishing Corporation

1309 Noble street, Philadelphia, Pa. Editorial and Executive Offices: 30 Church street, New York, and 105 West Adams street, Chicago. Branch offices: Terminal Tower, Cleveland; 1081 National Press bldg., Washington, D. C.; 1038 Henry bldg., Seattle, Wash.; Room 1001, 485 California street, San Francisco, Calif.; 530 W. Sixth street, Los Angeles, Calif.

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Subscriptions (including, when published, the daily editions of the Railway Age, published in connection with the convention of the Association of American Railroads, Mechanical Division), payable in advance and postage free, United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Foreign countries, not including daily editions of the Railway Age: 1 year, $4; 2 years, $7. Single copies, 35 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.), and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

May, 1939

Volume 113 *No. 5*

Locomotives:

Cars:

General:

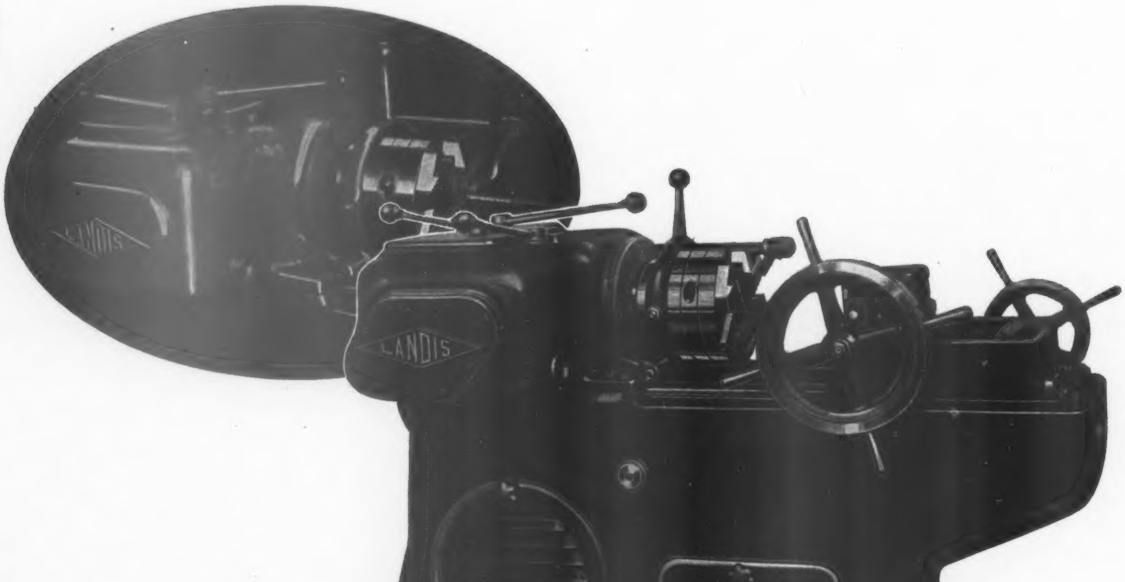
Editorials:

Car Foremen and Inspectors:

Back Shop and Enginehouse:

The LANDMACO Threading Machine

. . . assures Economy in Railroad Maintenance



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RAILWAY
MECHANICAL ENGINEER

C. B. & Q. Installs

"General Pershing" Zephyr

Each passenger car in four-car motor train carries 30-kw. Diesel-electric auxiliary plant for lighting, heating and air conditioning — Non-power trucks are all fitted with disc brakes — Passenger-carrying units are lighted by fluorescent lamps

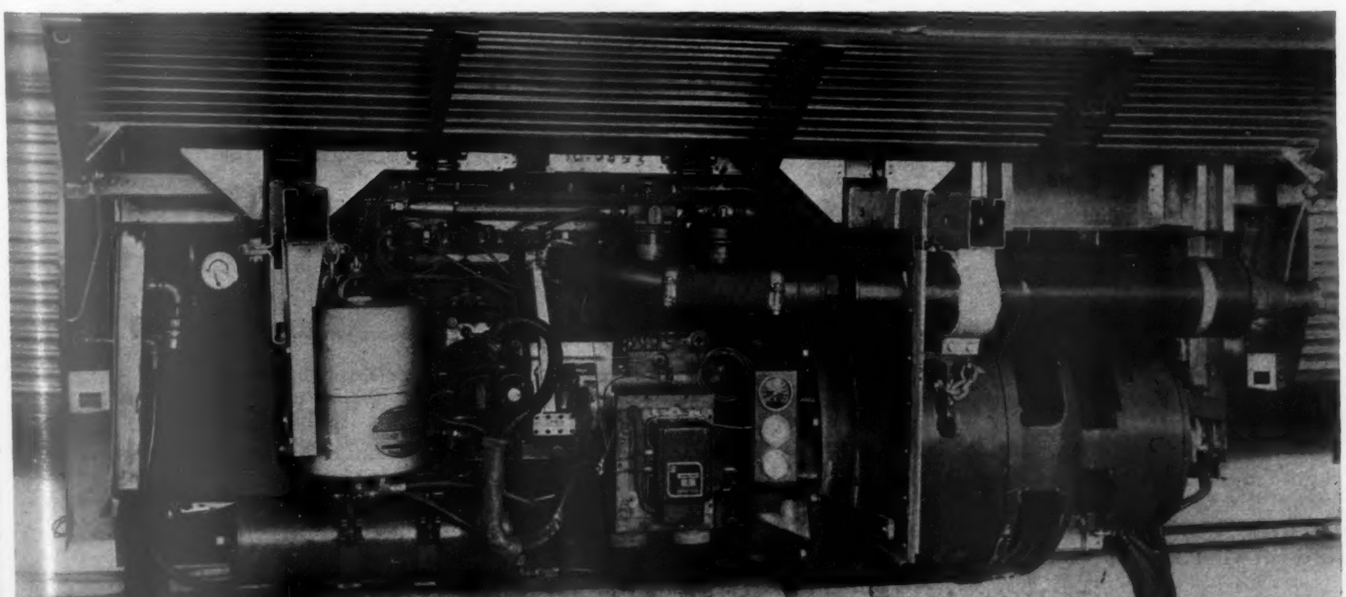
THE complete installation of fluorescent lighting, Diesel-driven auxiliary power plants, and disc type brakes on the trucks characterize each of the passenger-carrying cars on the four-car motor train recently delivered to the Chicago, Burlington & Quincy by the Edward G. Budd Manufacturing Company. This train, of stainless-steel construction, is powered by a 1,000-hp. Electro-Motive Corporation Diesel-electric power plant installed in the front end of the power-baggage car.

The train, which went into service between Kansas City, Mo., and St. Louis on April 30, is christened the "General Pershing," and the name of each of the cars is suggestive of a military career. Thus the power-baggage unit is designated the "Silver Charger" and each of the passenger-carrying cars bears the name of an emblem of military rank. These are, successively, the "Silver Leaf," the "Silver Eagle," and the "Silver Star."

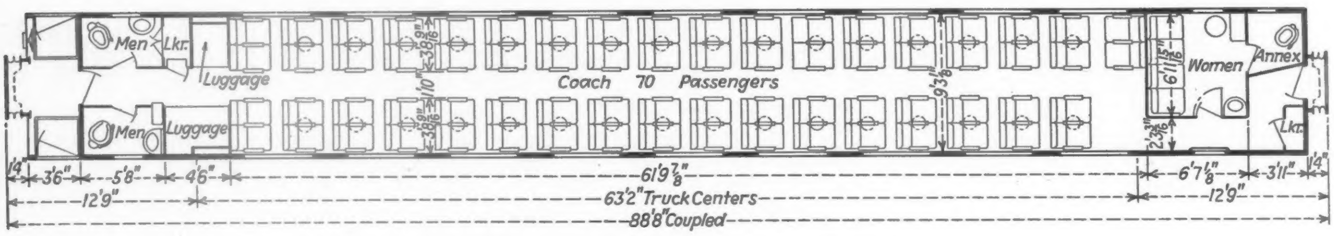
The train provides daylight facilities for 122 coach passengers, with dining service, and a lounge for 22. In front of the engineroom in the first car is a roomy operator's compartment. Back of the engineroom is a 40-ft. baggage room. There are two coaches, the first of which seats 70 passengers, and the second 52 passengers. Each of these cars has a women's lounge, and the second has a men's lounge as well. These cars are vestibuled at one end only. The last car is the diner-lounge. The dining room has three double tables on each side of the aisle, thus seating 24 persons. The dining and parlor-lounge units are separated by the entrance vestibule.

The Car Structures

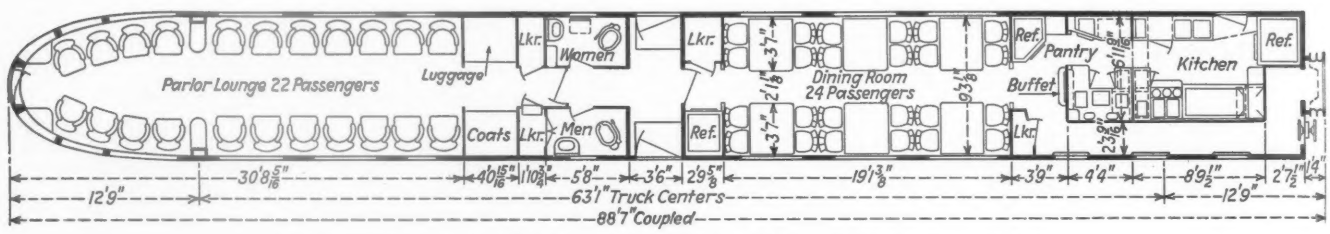
The cars are of Budd stainless-steel construction, the parts of the structure being joined by the Shotweld process. The center sill is built-up of shapes drawn from stainless-steel sheets. It has a cross-sectional area of 12.63 sq. in. The section is symmetrical about both vertical and horizontal center lines, and the line of draft falls on its center of gravity. The rubber draft gears and buffers are of Budd design.



The Diesel-electric power plant which furnishes energy for heating, lighting and air conditioning



The 70-passenger coach has a women's lounge



The lounge-diner—The vestibule is between the dining and parlor lounge sections

In the two passenger cars and in the parlor-lounge there are continuous bag racks of the closed type. The windows are rubber-glazed units with ¼-in. plate glass outside and shatterproof glass in the inside hinged sash. The curved windows in the observation room at the end of the fourth car are double rubber-glazed units. The seats in the coaches are Karpen lightweight, double rotating type, except at the bulkheads where fixed seats are installed. Karpen metal-frame club chairs are used in the lounge and General Fireproofing aluminum-frame chairs in the dining room.

Train Power Supply

The power plant on each passenger-carrying car—for lighting, air conditioning, and heating—consists of a Hercules 69-hp., six-cylinder Diesel engine, directly connected to a General Electric 1,800-r.p.m., three-phase, 220-volt, 30-kw. electric generator. The operation is regulated by a Minneapolis-Honeywell control system. The power unit is mounted under the car in a sound-deadening inclosure, suspended from a sliding carriage on U. S. Rubber mountings at three points. The engine carriage is mounted on a series of ball-bearing rollers, which permit moving the complete unit laterally from under the car so that all sides of the engine and generator are accessible for maintenance. To roll the unit out of the box it is necessary to take off the side door and remove safety bolts and the exhaust-pipe flange. The fuel-oil, circulating-water and electrical connections to the engine and generator are permanently connected flexible lines. In the event of a power-plant failure, the crippled car may be supplied with power from an adjacent car through a three-wire train line and car connector.

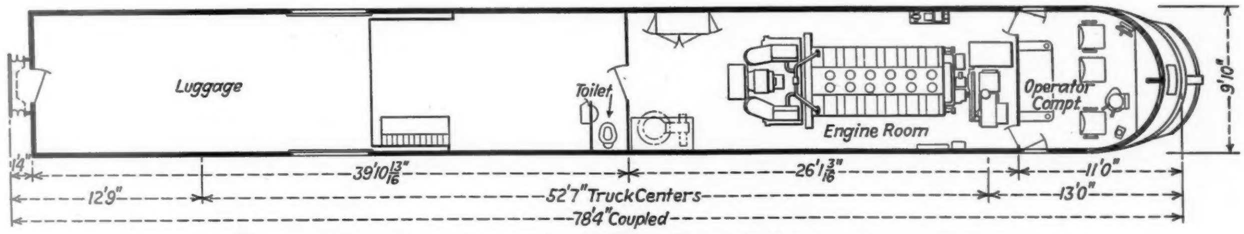
Weights of the Cars in the C. B. & Q. "General Pershing" Zephyr

	Body: Dry weight, lb.	Body: Ready for service, lb.	Trucks, lb.	Total ready to run, lb.	Revenue load, lb.
Power-baggage unit	121,945	134,185	67,635	201,820	32,000
70-passenger coach	70,443	73,190	35,210	108,400	11,200
52-passenger coach	67,603	69,790	35,210	105,000	8,320
Diner-lounge	77,523	87,330	36,470	123,800	7,120

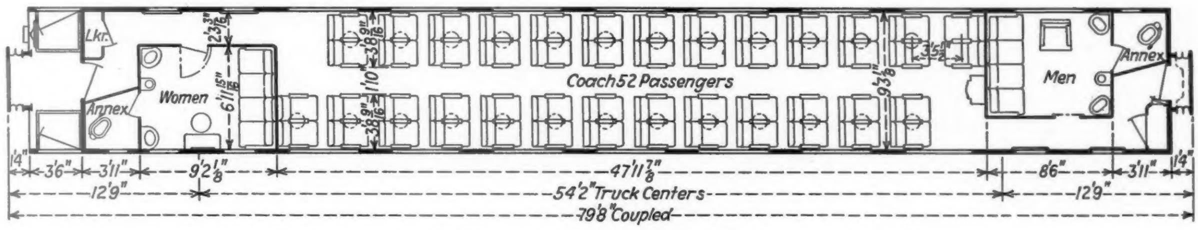
Car Heating

During cold weather the cars are heated by waste heat from the engine jacket water and by electric heaters. The jacket-water heat is distributed through the duct air-distribution system from an overhead radiator, and the electric heaters placed in housings on the floor close to the side walls can be connected in various Y and delta combinations to meet the heating requirements. The individual heating units are so located that there are no hot spots under any connection arrangement. Beginning at 45 deg. F. outside temperature, a small amount of electric heat is used, and this is increased in 5-kw. steps to the maximum. The waste heat from the engine supplies from two-thirds to three-fourths of all the heat required, but cannot be used to the exclusion of the electric heat, since it is necessary to have load on the generator to develop heat in the engine jacket water. The minimum amount of electric heat used is 5-kw. and the maximum is 20-kw.

One of the coaches photographed by the illumination from the fluorescent lamps



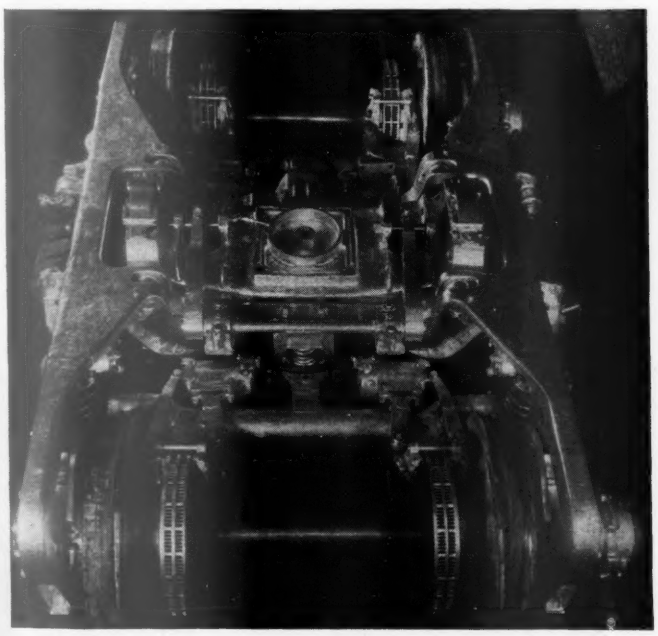
The power-baggage car houses the 1,000-hp. Electro-Motive traction power plant



Lounges are provided in the 52-passenger coach for both men and women

The exhaust gas line from the engine is water-jacketed to the extent necessary to supply the required heat to the cooling water. After the cooling water is discharged from the engine, it passes through a service water heater. There is no storage of hot water, since the service-water heater is instantaneous in action.

From the service-water heater the water passes through a circulating pump and then through an electric immersion heater, which has a three-fold purpose. First, it is used to supply heat to water for standby service in winter. Second, it supplies heat to the car and to the Diesel engine under parking conditions. Third, in cold weather, when the car is being put into service from a cold start, the electric immersion heater is used to warm the Diesel engine sufficiently to make starting easy (50 deg. F.).



Top view of a four-wheel truck showing the disc brake units

Water from the electric immersion heater is piped to a three-way proportioning valve, which is placed so that the total supply of water, or such an amount as is required by the controlling thermostat in the car, may be directed to the overhead radiator in the ventilating duct. The other line from the three-way valve bypasses the radiator and goes into a return line.

The return line is divided, one branch passing to a mixing valve and the other one to Diesel engine radiators under the car, which remove excess heat remaining in the water after that required for car heating or service-water heating has been utilized. The line from the Diesel radiators under the car also passes to the mixing valve, which blends the warm water returning with the cold from the Diesel radiator so that the water always goes to the engine jacket at a fixed temperature of 165 deg. F. the position of the valve is controlled by a bellows thermostat.

The electric immersion heater is an insulated stainless-steel tank containing four 6-kw. heating units. It can be supplied with energy only from a standby source, and is not used when the engine is running.

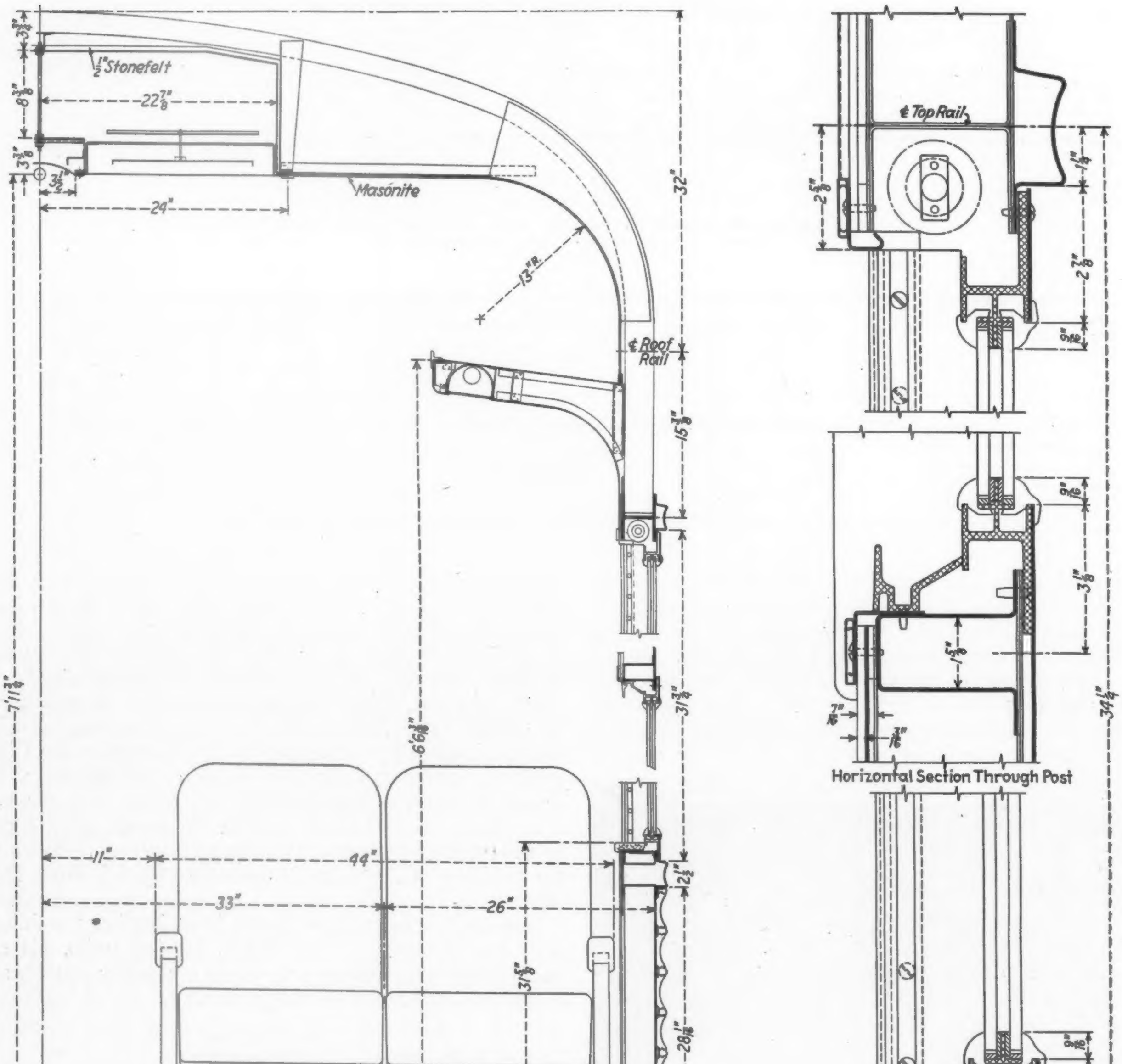
Car Cooling

The G. E. motor-driven compressor which supplies refrigeration does not cycle in the usual manner, but starts automatically when the outside temperature reaches 60 deg. F. and runs continuously as long as the temperature is above that point. At the lower cooling temperature, 75 per cent outside air is admitted through the evaporators and, as the outside temperature rises, the amount of fresh air admitted is reduced automatically from 75 to 25 per cent by dampers in the intake air ducts.

Under these conditions the amount of cooling supplied is in excess of the car requirements, and the air, after being cooled to a low temperature, is reheated to the proper temperature by engine jacket water. This procedure effects maximum dehumidification of the air and minimizes loss of refrigerant caused by starting and stopping of the compressor.

Air sterilization equipment is installed in the path of the recirculating air. It consists of nine 15-watt Westinghouse Sterilamps, which are vacuum tubes made of special glass. They emit ultra-violet light which destroys air-borne bacteria. The Minneapolis-Honeywell temperature-control system maintains an air condition inside the car based on wet-bulb temperature, which is made to vary as a differential of outside temperature.

The air compressor on each of the three cars is a 7½-ton unit, driven by a 10-hp. 3-phase 60-cycle 220-volt a.c. motor. The evaporators in the two coaches



A coach cross-section and enlarged sections through the side walls

each has a capacity of 7½ tons, while the diner-lounge car is equipped with two 4-ton units, one for each half of the car.

Lighting

All of the general lighting and some lighting for special applications is accomplished with G. E. fluorescent units. In the 70-passenger coach a continuous line of 36-in. 30-watt lamps are placed in a shallow circular-arc white reflector extending the entire length of the passenger section. No louvers or other form of light-source protection or control is used.

The center units are supplemented with an 18-in. 15-watt fluorescent unit behind ribbed glass recessed into the baggage racks over each double seat. These can be controlled individually by a small toggle switch at the side of each unit. There is a total of twenty 30-watt and thirty-six 15-watt units, and the illumination on the 33-in. 45-deg. reading plane varies from 20 to 24 foot candles.

In addition to the general lighting, there are 10 blue night lights recessed at even spacings into the center lighting fixture. There are also two 25-watt incandescent vestibule units, four 25-watt incandescent passageway units, two 15-watt fluorescent fixtures in the lavatory, three 15-watt ceiling fixtures, and one dressing table fluorescent lamp in the women's lounge and one 25-watt incandescent unit in the women's annex.

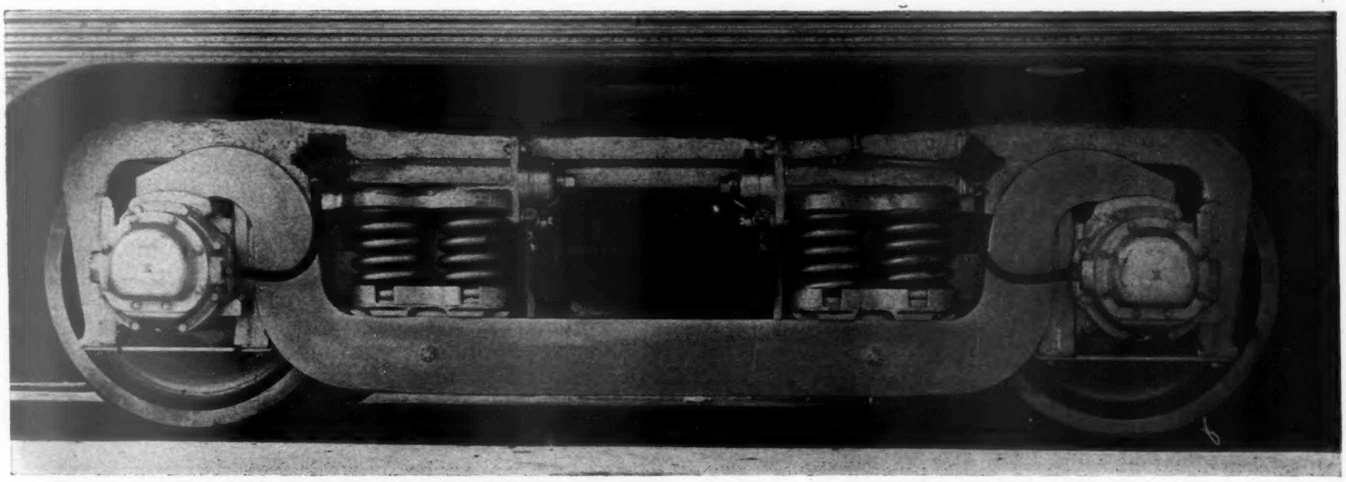
The 52-passenger coach is lighted in a similar manner, except that there are fewer units in the passenger section and more in the lounge. Both the lounge and dining sections of the diner-lounge also have the continuous central lighting fixtures. In the lounge section these are supplemented with 18-in. fluorescent units recessed into the baggage racks, like those in the coaches. There are also continuous built-in coves over the rear windows, in which 18-in. fluorescent lamps are used. In the dining section, the central lighting is supplemented by a 36-in. fluorescent lamp in a cove over each window. This arrangement produces a lighting intensity of 43 foot candles on the table top adjoining the windows and 24 adjoining the aisle. Fluorescent lights are also used over the buffet and in the lavatories. The kitchen, pantry, vestibules, the two marker lights, and the back-up light are all lighted with incandescent lamps.

Auxiliary Electrical Equipment

In addition to the Freon compressor motor, the air-conditioning system employs a Freon-condenser-fan motor, a Diesel circulating-pump motor, a Diesel-radiator-fan motor, an air-duct blower-fan motor, exhaust-fan motors, a damper-control motor, and a three-way-valve-control motor. There is also an air-compressor motor which is used only if the train-line air is not maintained, and compressor and fan motors are required for the water coolers. These create a total power demand of 13.3 kw. The minimum demand for lights is 1.6 kw. and the maximum 4.3. The air sterilization apparatus requires 0.2 kw. The maximum generator load for summer operation is 17.8 kw. and for winter, 30.5 kw. There are also 110-volt outlets in the lounges and lavatories.

Each car is equipped with a Motorola automobile-type radio with two loud speakers. In the coaches the speakers are placed in the front and rear bulkheads of the passenger section, and in the diner-lounge car there is one speaker in each section. An Exide 150-amp. hr. storage battery is used on each car for engine starting and auxiliary-power supply. It is charged from the exciter only.

Wayside power is obtained through 3-pole, 100-amp., 250-volt receptacles, one on each side of the car. A relay locks out the contactor on this circuit when the engine is operating. The electric control for air brake and signals is carried between cars by two 8-point, 20-amp., 250-volt receptacles and jumper assemblies. For train-power emergency connections, there are 3-pole, 200-amp., 250-volt receptacles, two at each end of the car, where such connections may be required. Each car also carries one jumper assembly. To prevent freezing or the formation of rime in drain openings, they are jacketed with thermostatically controlled electric heaters. Electric heaters are also used in the diner-lounge toilets, which are subject to exposure when the car is parked, and there is one heater used in the kitchen to prevent freezing of water. Electric space heaters in the heat-insulated battery box protect the battery from low temperatures.



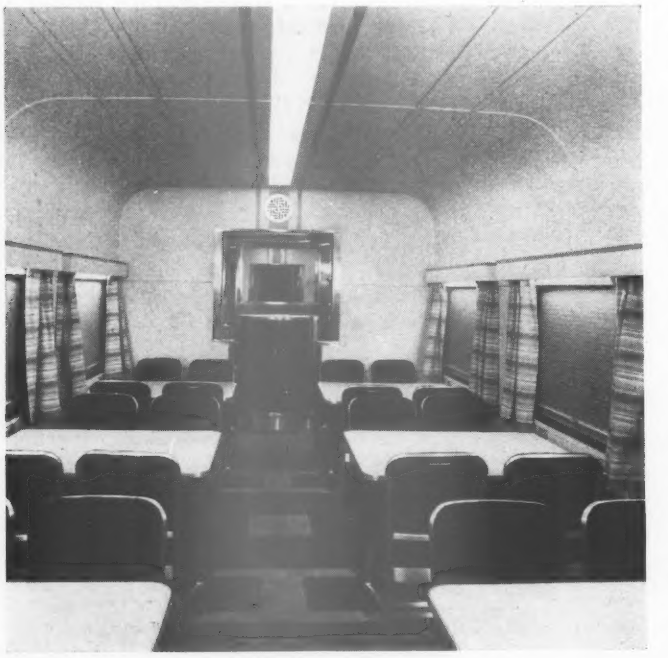
Decelostats are installed on each axle of all trucks except the power truck

The Brakes

The trucks under the passenger-carrying cars and the rear truck under the power-baggage car are of the four-wheel type with alloy cast-steel frames and bolsters furnished by the General Steel Castings Corporation. These trucks have a 9-ft. wheel base and are of the double equalizer type with helical equalizer springs and elliptic bolster springs. The lateral motion of the bolsters is checked by Houde shock absorbers. All axles of the

four-wheel trucks are fitted with Timken roller bearings. With the exception of the rear power-baggage-car truck and the leading diner-lounge-car truck, which have 6-in. by 11-in. journals, the journals are 5½-in. by 10-in. An unusual feature in the design of these trucks is the use of a torque type lateral stabilizer which prevents the truck bolster from tilting under loads concentrated on one side bearing.

The outstanding feature of the four-wheel truck is the disc brake developed by the Budd Wheel Company. Essentially, this brake consists of a disc and a pair of shoes, one of which bears against each face of the disc. The outer and inner disc faces against which the shoes bear are separated by radial vanes which act as impellers to induce a radial air flow between the inner walls of the braking surfaces, thereby expediting the dissipation of the heat generated in braking.



The dining room

A disc, with its brake-shoe combination, is mounted against the inside hub face of each wheel. Each segmental brake shoe covers approximately one-third of the disc circumference. The shoes are operated by a pair of tongs fulcrumed on a transverse tubular support, lying just outside of the disc and wheel radius. A brake cylinder is hung on the outer extremity of one of the tongs and the piston rod connected to the other. In this manner the bearing pressure between the two shoes operating on each disc is equalized. The shoes, themselves, are in turn hinged to their respective tongs so that they may aline themselves freely with the disc surfaces.

The tubular C-frame upon which the tongs are fulcrumed extends transversely across the truck and beyond the wheels where it is suspended on the journal boxes by integral side arms which reach in radially outside of the wheels. A torque arm on the center of the transverse member of the C-frame is spring supported at the center of the truck transom. The brake cylinders and brake shoes thus have a three-point suspension of essentially the same type as that of a nose-suspended traction motor. The brake shoes, therefore, always remain in fixed radial relation to the axle, and the application of the brakes does not interfere with the full resiliency of the truck suspension.

The wearing faces of the brake shoes comprise a number of segments of automotive type composition lining which are spaced apart and rubber supported on the shoe retainer. This facilitates the maintenance of uniform bearing pressure and improves heat dissipation.

The relatively large surface area on the two sides of each brake disc, combined with the ventilating feature, provides for a high rate of heat dissipation and the maintenance of surface temperatures lower than those developed at the brake-shoe and wheel-rim surfaces with the conventional brake. These factors are expected to effect a more uniform coefficient of friction throughout the duration of brake applications.

The air-brake equipment on this train is the Westinghouse high-speed-control type embodying electro-pneumatic, straight-air and automatic-pneumatic control features. In addition to these regular features of the H. S. C. equipment, this installation embodies the first application of a new means of insuring the highest practicable rate of retardation at all times with protection against wheel sliding. The function is effected by a Decelostat installed on each non-power axle in the train and a Decelostat valve installed at each truck. This equipment operates to check the progress of incipient wheel sliding.

The Decelostat is a rotary inertia device, with its rotor driven through a leaf spring from one end of each axle. The tension of this spring is subject to adjustment. If the axle is decelerated rapidly, as during incipient wheel sliding from a brake application, the inertia of the rotor causes it to tend to overrun the wheel speed, a tendency resisted by the flexing of the leaf spring. As the rotor overruns the wheel speed and, therefore, turns a limited amount on its supporting shaft in the direction of rotation, it closes an electric circuit leading to magnets on the Decelostat valve and on the automatic sanding relay. The valve responds immediately to reduce brake-cylinder pressure quickly through its large capacity relay valve. Coincidentally, the magnets on the electro-pneumatic time-limited sanding system are energized. Sand is thereby ejected on to the rail from the power unit and from the first car for a definite, predetermined interval. When the wheel has resumed its normal speed of rotation by the momentary reduction of brake force, the Decelostat rotor again revolves in synchronism with axle

The torque stabilizer installation on the four-wheel truck

(Continued on page 186)

Association of American Railroads

Passenger Locomotive Tests*

Runs with identical 1,000-ton train on three railroads provide valuable data on high-speed train resistance and drawbar horsepower requirements for operation at 100 m. p. h. on level tangent track

At a meeting of the General Committee of the Mechanical Division of the Association of American Railroads in June, 1938, the Committee on Further Development of the Reciprocating Steam Locomotive presented a progress report. The latter committee was then instructed to prepare plans and was subsequently authorized to conduct a series of road tests to determine the drawbar horsepower required to haul a 1,000-ton train at a constant speed of 100 m.p.h. on level tangent track.

In October, 1938, a 16-car test train was assembled and tests were conducted on the Pennsylvania, the Chicago & North Western, and the Union Pacific. The train, which was assembled by the Pennsylvania from its own rolling stock, consisted of 14 P70 coaches, a B60b baggage car, and a dynamometer car. The dynamometer car and the baggage car both had 5½-in. by 10-in. journals and single brake shoes, and the 14 P70 coaches had 5½-in. by 11-in. journals and clasp brakes. All cars were carried on four-wheel trucks. The baggage car weighed 44 tons; the other cars varied from 63 to 64.85 tons; the total weight of the train was 1,005.2 tons, and the average weight per car was 62.82 tons.

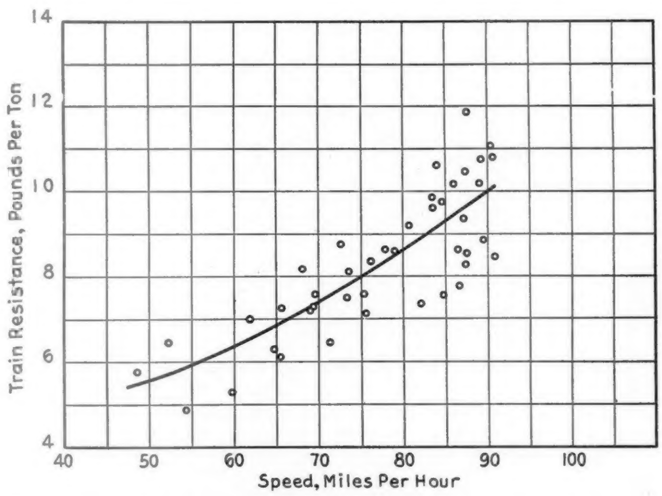


Fig. 1—Train-resistance as determined on the Pennsylvania—Passenger cars with four-wheel trucks—Average weight per car 62.82 tons

Six different locomotives were used on the round trip from Fort Wayne, Ind., to Grand Island, Neb. On the Pennsylvania, the locomotives used were Class K4s Pacifics; on the C. & N. W., Class E4 4-6-4 type built during 1938, and on the Union Pacific, Class FEF1, 4-8-4 type, built in 1937.

The test train was operated through Indiana, Illinois, Iowa, and part of Nebraska, and the total miles run, eastbound and westbound, was 1,560. In the first three named states the gradient was rolling, while in Nebraska there was a continuous ascending grade westbound. The maximum grade on any railroad was 1.25 per cent. The rail weight on the Pennsylvania was 131 lb. per yd., and on the other railroads, in general, 100 lb. per yd. A short stretch of the Union Pacific was laid with 110-lb. rail. The ballast on the Pennsylvania was crushed limestone; on the Chicago & North Western, cinder, gravel, stone, and crushed rod. On the Union Pacific, the ballast was gravel from Sherman, Wyo. A few miles were ballasted with sand, cinders, or slag.

A report of the results of the tests follows:

Train Resistance on Level Tangent Track

Over several stretches during each of the test runs the train resistance was carefully computed from the dynamometer car records and corrected for grade and acceleration, to determine the train resistance in pounds per ton, on level tangent track.

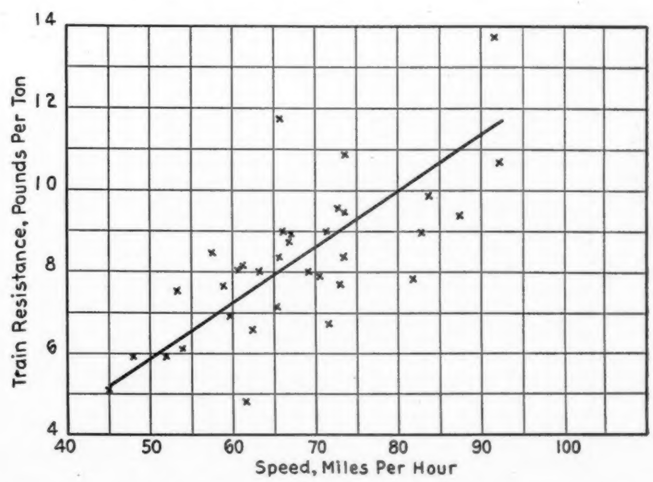


Fig. 2—The train-resistance measurements on the Chicago & North Western—Passenger cars with four-wheel trucks—Average weight per car 62.82 tons

The resistance in pounds per ton, over the test stretches, has been plotted separately for each railroad on Figs. 1, 2 and 3, and average curves have been drawn through the points.

In Fig. 4 the resistance curves for each railroad are shown, together with a curve based on the Davis formula. Although the identical train with the same dynamometer car and crew was used on all three railroads, the resistance varied considerably, and the only explanation may be the difference in track structure.

The tests were run in moderately warm weather, with low wind velocity, and, therefore, any resistance curve

* Abstract of the report of the A. A. R. Passenger Locomotive Tests, October, 1938, issued by the office of the Mechanical Engineer of the Mechanical Division, February, 1939.

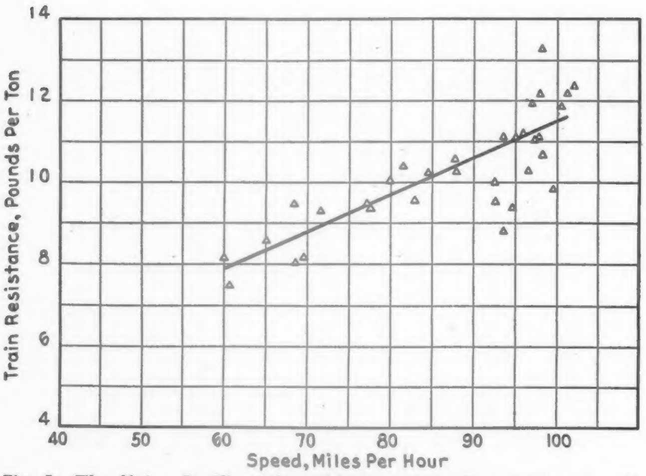
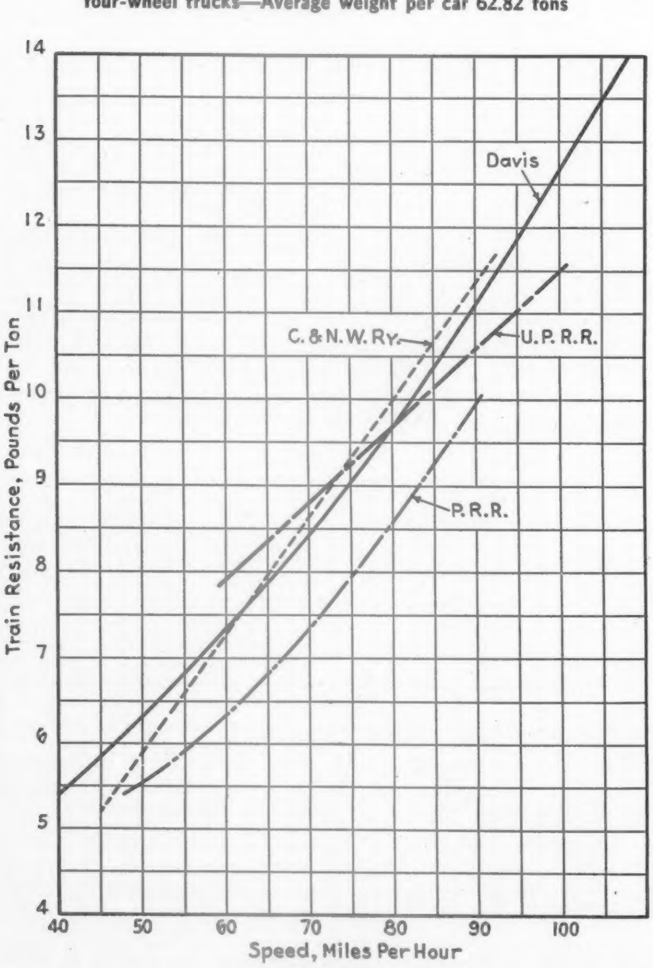


Fig. 3—The Union Pacific train-resistance curve—Passenger cars with four-wheel trucks—Average weight per car 62.82 tons



Davis Formula

$$R = 1.3 + \frac{29}{w} + 0.03V + \frac{0.041V^2}{wn}$$

R = Resistance in pounds per ton
n = Number of axles per car
w = Weight per axle in tons
V = Speed in miles per hour

Fig. 4—The three train-resistance curves compared with the Davis Curve

that is to be used by the designer or operating officer should be selected with due regard for weather conditions. With this consideration in mind, the curve based on the Davis formula is as representative of the test data as any other that could be drawn.

Maximum Drawbar Horsepower

While the tests were run primarily to determine the train resistance at high speeds, the maximum drawbar horsepower developed by the test locomotive is of interest and has been plotted separately on Figs. 5, 6, and 7, respectively, for each type of locomotive used. The figures represent the adjusted horsepower that would have been delivered at the rear of the tender if the locomotive had been running at constant speed on level tangent track.

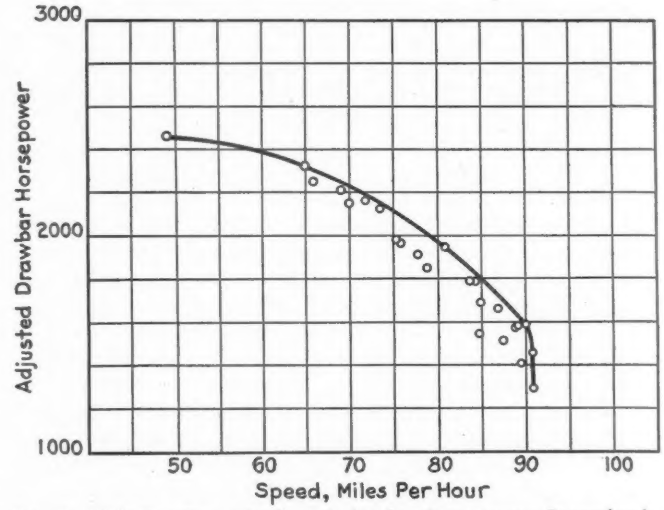


Fig. 5—Highest values of adjusted drawbar horsepower—Pennsylvania class K4s locomotive

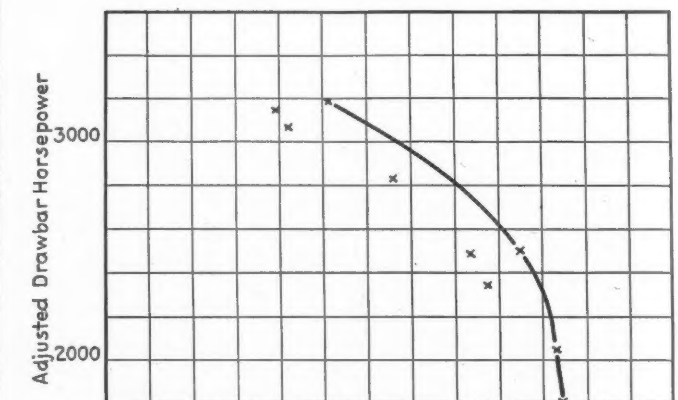


Fig. 6—Highest values of adjusted drawbar horsepower—C. & N. W. Class E4 locomotive

Acceleration Distances for Various Horsepowers—1,000 Tons Trailing Load

Maximum drawbar horsepower	Distance, miles, to accelerate between speeds of, m. p. h. 0-50	50-80	80-100
3,000	1.51	13.98	....
4,000	1.13	6.36	....
5,000	0.93	4.41	29.00
6,000	0.80	3.48	10.74
7,000	0.71	2.92	7.13

Rate of Acceleration—Tests

The Davis curve in Fig. 4 shows that the resistance of the test train on level tangent track at a speed of 100 m.p.h. is 12.67 lb. per ton and, therefore, to haul the test train weighing 1,000 tons at a speed of 100 m.p.h. on level tangent track will require a drawbar pull of 12,670 lb. and a horsepower of 3,379 delivered at the

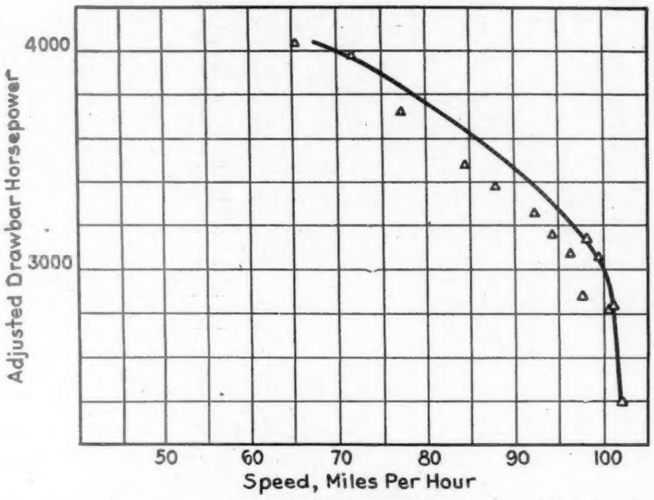


Fig. 7—Highest values of adjusted drawbar horsepower—Union Pacific Class FEF1 locomotive

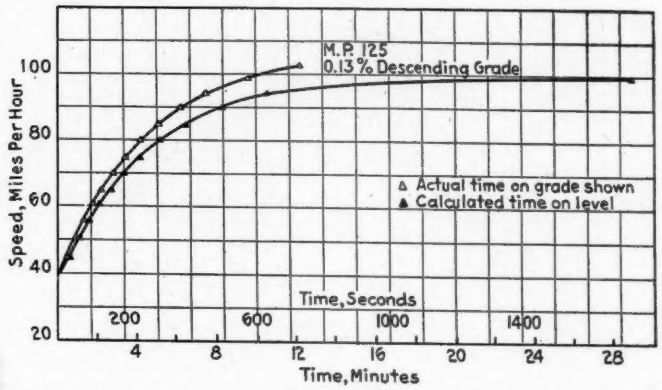


Fig. 9—Speed-time curve of the Union Pacific 4-8-4 type locomotive hauling the test train

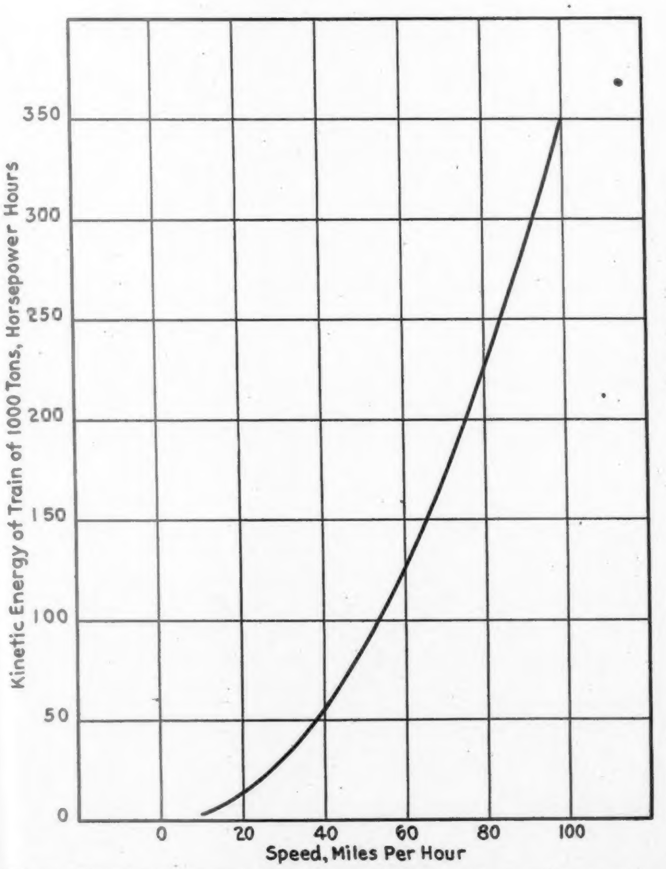


Fig. 8—The kinetic energy stored in a 1,000-ton train at various speeds

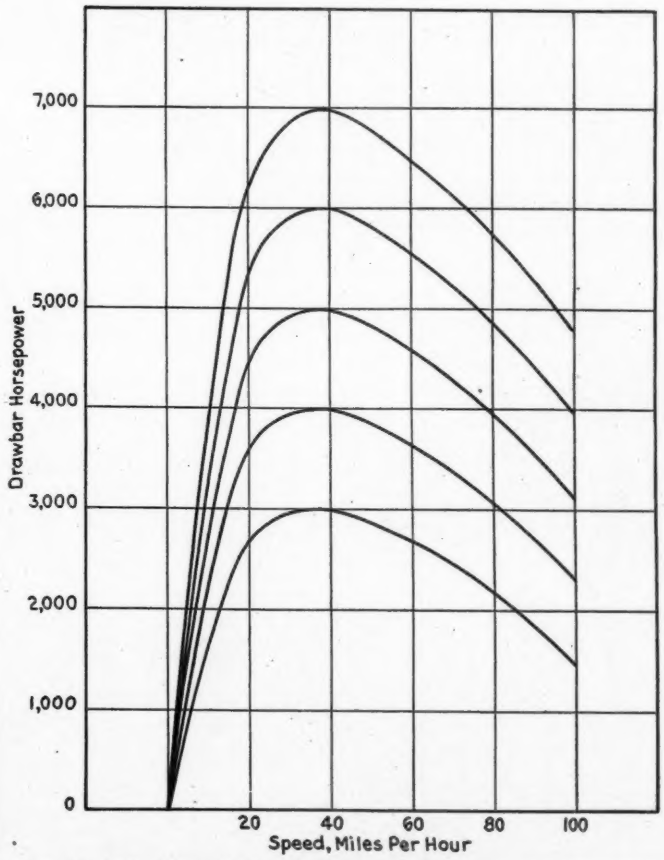


Fig. 10—Calculated drawbar-horsepower-speed curves for locomotives developing 3,000 to 7,000 drawbar horsepower

rear of the tender. This is a comparatively moderate power; but, if a train is to run at 100 m.p.h., it must first be accelerated up to that speed and the rate of acceleration will depend upon the amount of power that can be delivered by the locomotive in excess of that required to haul the train at a constant speed. The kinetic energy of the train, which must be supplied by this excess power, varies as the square of the speed, as shown by the curve on Fig. 8.

In conducting the high-speed tests, as the maximum speed was approached, the great time and distance required to make a small increase in speed became very noticeable. The highest speed of the tests was made on the Union Pacific, and the acceleration curve shown in Fig. 9 shows that it required 7 min. to accelerate from 80 to 100 m.p.h., although the train was on a descending grade of 0.13 per cent. On the same diagram is another curve showing how the speed would have increased if the grade had been level. It would then have required 16 min. 10 sec. to reach a speed of 99 m.p.h. and no higher speed could have been obtained unless the locomotive could develop more horsepower than it did in the test.

Rate of Acceleration—Calculated

After the running resistance has been determined, the time and distance required to accelerate a train can be calculated for any given drawbar horsepower, but since the mass of the locomotive and tender must also be accelerated, their weight must be known or assumed and taken into account.

To be able to plot a series of acceleration curves approximating actual conditions with existing steam locomotives, a series of drawbar horsepower-speed curves

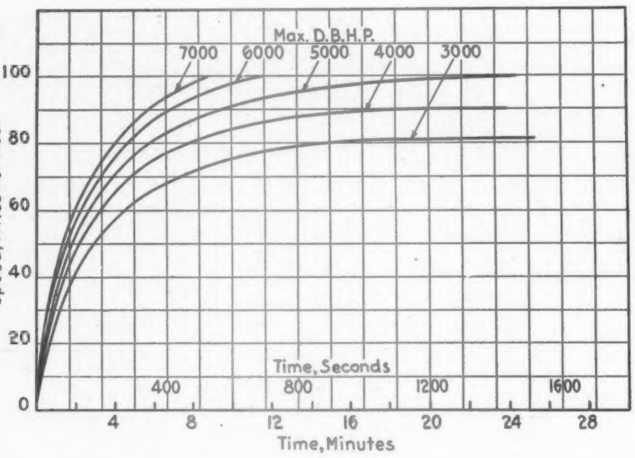


Fig. 11—Speed-time curves for a 1,000 ton train (trailing load) on level tangent track, with drawbar horsepowers from 3,000 to 7,000

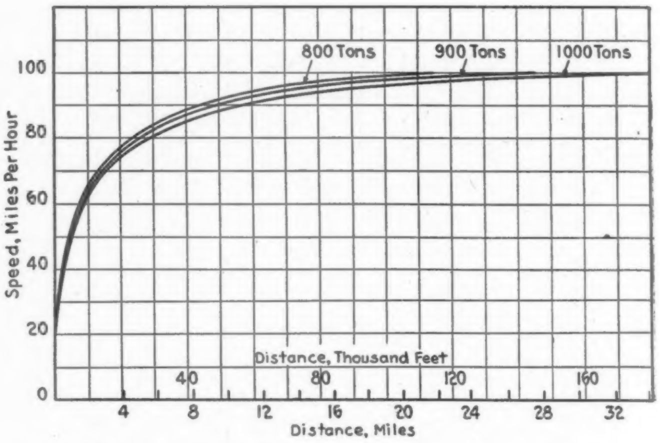


Fig. 14—Speed-distance curves for various trailing loads on level tangent track, hauled by a locomotive developing 5,000 maximum drawbar horsepower

have been plotted in Fig. 10 for locomotives developing maximum drawbar horsepowers of 3,000 to 7,000. These curves were obtained from the Cole formula for cylinder horsepower which assumes that the indicated horsepower remains constant above a piston speed of 1,000 ft. per min. For each curve 25 lb. per ton of estimated weight on drivers was deducted from the cylinder tractive force in accordance with American Locomotive Company practice to get the horsepower developed at the drivers, after which the resistance of the engine, trailer, and tender trucks, and the head end air resistance was calculated by the Davis formula and deducted to determine the horsepower delivered at the rear of the tender. The curves in Fig. 10 do not represent actual locomotives, but they will serve to show the relation between power and rate of acceleration and closely represent what is now attained in actual practice.

Acceleration curves, based on these calculated horsepower curves, are shown in Figs. 11 and 12.

With a maximum of 5,000 drawbar horsepower, it requires only 0.93 miles to accelerate to 50 m.p.h., another 4.4 miles to accelerate to 80 m.p.h., and 29.0 additional miles to accelerate to 100 m.p.h. In other words, if after reaching a speed of 100 m.p.h., the train were required to slow down to 80 m.p.h., it would require 29.0 miles on level track to get back to 100 m.p.h. It is evident that if much running is to be done at a speed of 100 m.p.h., the rate of acceleration will have to be much faster than this, and a locomotive developing a maximum of only 5,000 hp. will not be large enough if its horsepower-speed curve is similar to that in Fig. 10.

Reference to Fig. 12 shows that it takes longer to

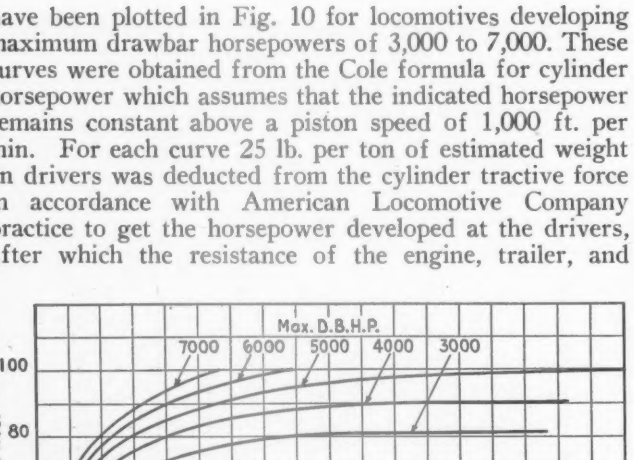


Fig. 12—Speed-distance curves for a 1,000 ton train (trailing load) on level tangent track, with drawbar horsepowers from 3,000 to 7,000

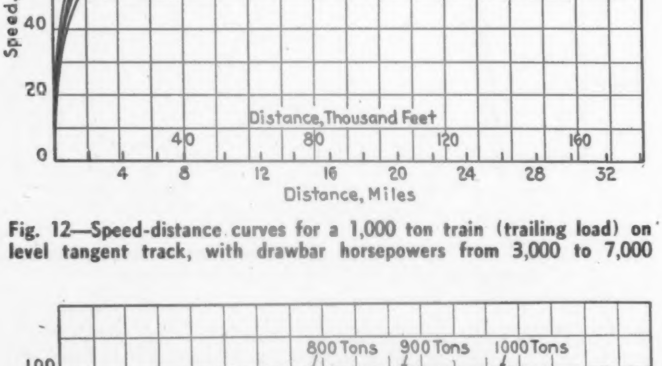


Fig. 13—Speed-time curves for various trailing loads on level tangent track, hauled by a locomotive developing 5,000 maximum drawbar horsepower

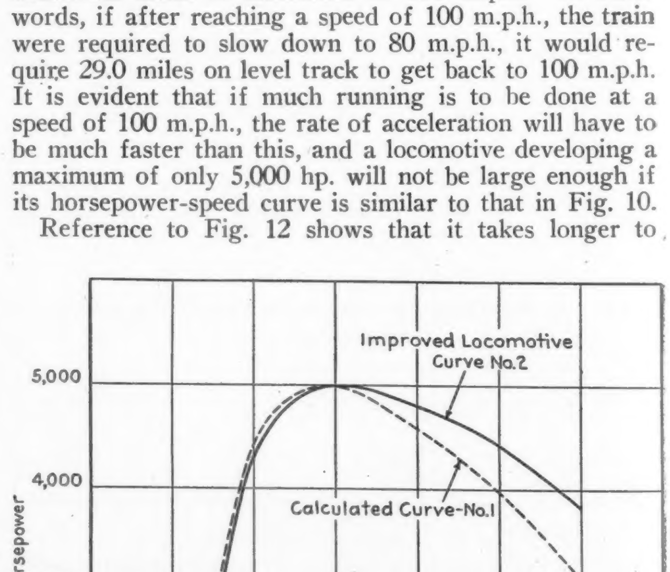


Fig. 15—Comparison of calculated and "improved" drawbar-horsepower-speed curves—5,000 maximum drawbar horsepower

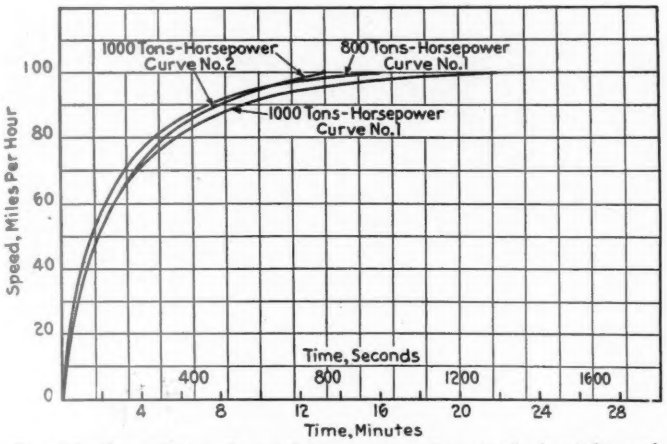


Fig. 16—Comparison of speed-time curves for standard-weight and lightweight trains hauled by locomotives with calculated and "improved" drawbar-horsepower curves

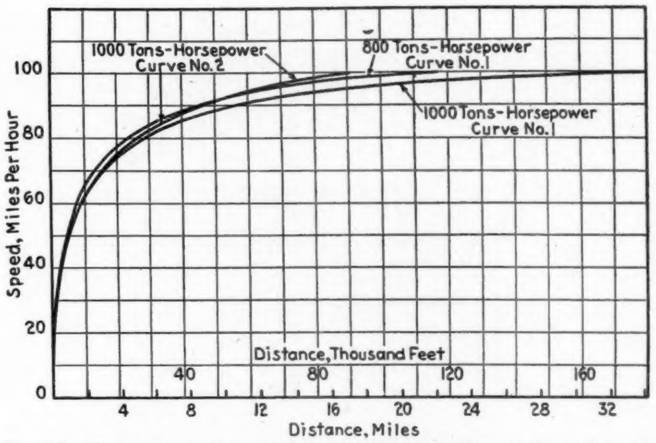


Fig. 17—Comparison of speed-distance curves for standard-weight and lightweight trains hauled by locomotives with calculated and "improved" drawbar-horsepower curves

accelerate from 80 to 100 m.p.h. than it does to accelerate from 0 to 80 m.p.h. The difference in acceleration, time and distance is much greater at the higher speeds than it is at the lower speeds. The curves in Fig. 11 make it clear that when the drawbar horsepower decreases at the higher speeds, the time required to accelerate at these higher speeds is lengthened, and to make high-speed running practicable it is important to increase the maximum cylinder horsepower developed by the locomotive to overcome mechanical friction to sustain maximum drawbar horsepower at higher speeds.

Effect of Grade on Acceleration

All the curves so far discussed have been based on running on level tangent track. Running downhill will, of course, increase the rate of acceleration, and running uphill will decrease the rate. On a 0.1 per cent ascending grade, a 5,000 drawbar-horsepower locomotive will not accelerate the 1,000-ton train beyond a speed of 92 m.p.h. Even on a 0.3 per cent descending grade it will require about 5.65 miles to accelerate the train from 80 to 100 m.p.h.

Effect of Reduction in Weight of Train on Rate of Acceleration

If the power delivered by the locomotive cannot be increased enough to produce a satisfactory rate of acceleration, the time and distance required to reach high speed can be shortened by decreasing the weight of the train. The time and distance required to accelerate trains of three different weights have been plotted in Figs. 13 and 14, basing them on a locomotive developing a maximum of 5,000 drawbar horsepower. Reducing the weight of the train from 1,000 tons to 800 tons reduces the time and distance required to accelerate from 0 to 100 m.p.h. about 35 per cent. This is a very important gain. There is, however, another way to look at it. The curves also show that when the 800-ton train has reached a speed of 100 m.p.h., a 1,000-ton train will have reached a speed of 97.5 m.p.h., a difference of only 2.5 m.p.h. in speed.

In order to find out how much additional power would be required to accelerate the 1,000-ton train at the same rate as the 800-ton train, a new drawbar horsepower curve was assumed for a 5,000-drawbar-horsepower locomotive. This curve is shown in Fig. 15 in comparison with the corresponding curve in Fig. 10. It represents a moderate improvement in the power developed at high speeds which it should be possible to secure. The resultant acceleration curves are shown in Figs. 16 and 17. The improved locomotive will accelerate the 1,000-ton train to 100 m.p.h. in slightly less time and distance than the 800-ton train will require when handled by the other locomotive. If long trains are to be handled at a speed of 100 m.p.h., undoubtedly there will be required a reduction in the weight of the train as well as an improvement in the power produced by the locomotive at high speed.

General Observations

Nothing developed in the tests to indicate that any of the locomotives had reached the limit of boiler capacity. Therefore, the question of sustained power at high speeds becomes a question of mean effective pressure in the cylinders. It is evident that if the mean effective pressure remains constant as the speed increases, the power of the locomotives will increase with speed; but since the mean effective pressure for any given cycle of valve events necessarily decreases with the speed, the ideal locomotive must have port openings so large and so accurately timed that this decrease will be kept as low as possible until the maximum speed has been reached. Obviously, the mean effective pressure cannot be successfully sustained by lengthening the cut-off. On the other hand, high speeds should be accompanied by shortened cut-off. The factors of design which have a direct bearing on maximum mean effective pressure are as follows: (1) high boiler pressure; (2) minimum pressure drop from boiler to steam chest; (3) large steam chest volume; (4) maximum valve port openings; and (5) minimum back pressure in exhaust passages.

Other factors that affect the power delivered to the drawbar are machinery friction, rolling resistance, and head-end air resistance.

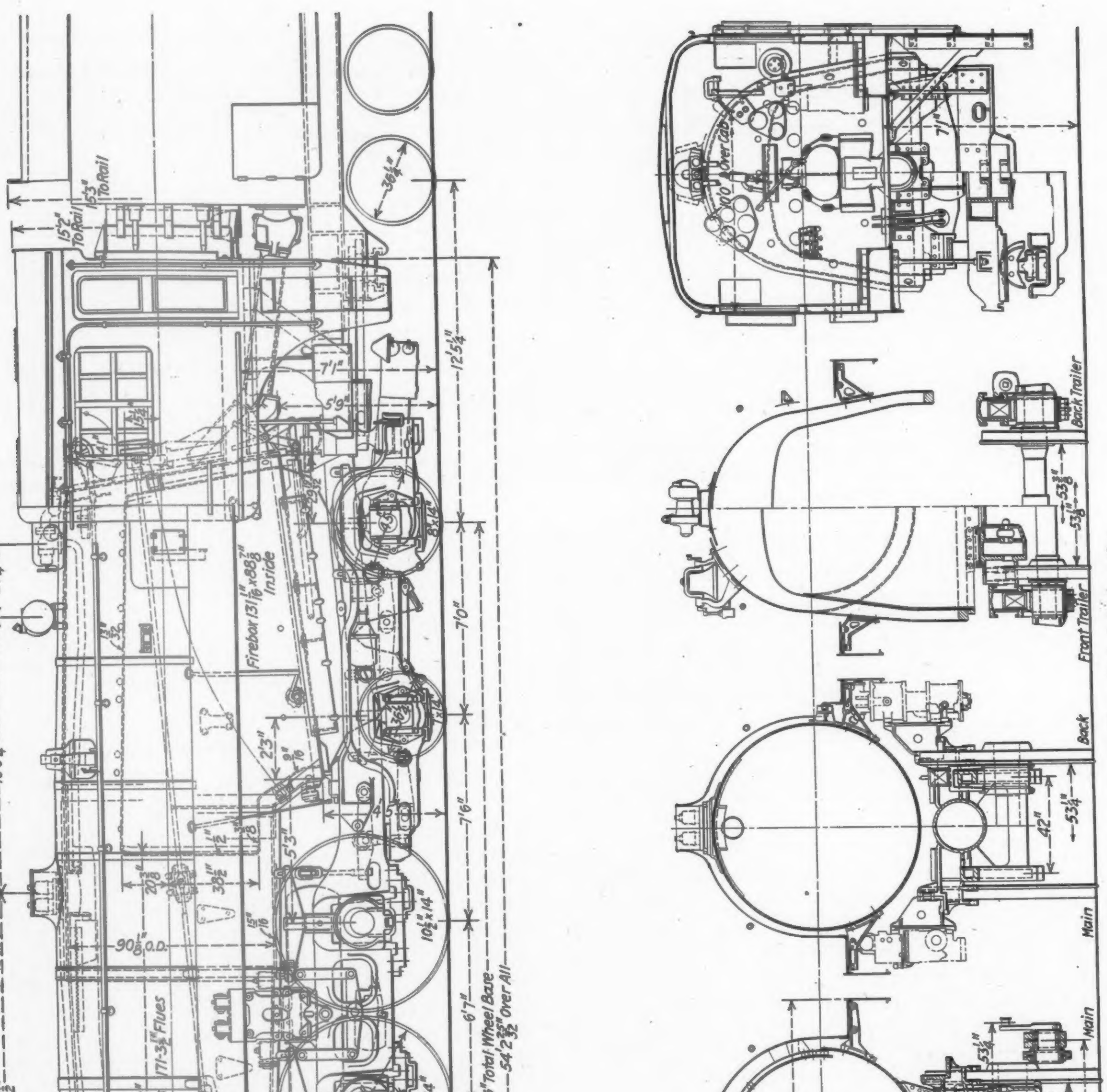
Conclusions

1—The maximum speed reached in the test was 102.4 m.p.h. After acceleration from a speed of 50 m.p.h. over a distance of 13 miles on a descending grade of 0.13 per cent, a speed of 100 m.p.h. was reached and maintained for 6 miles.

2—An estimate of the power required to haul passenger trains at high speed should be based on the Davis formula.

3—After the 1,000-ton test train had been accelerated to a speed of 100 m.p.h., it required 3,379 adjusted drawbar-horsepower to maintain that speed on level tangent track.

4—The table shows the distance which would be required to accelerate the 1,000-ton test train at various speeds and horsepower.



Elevation and cross section erecting drawings of the C. P. R. Class H-1-d locomotive

C. P. R. 4-6-4 Locomotives

Latest group of semi-streamline six-coupled passenger locomotives built by Montreal Locomotive Works have 57,250 lb. tractive force, with booster

THE delivery in August, 1938, of ten 4-6-4 type semi-streamline passenger locomotives to the Canadian Pacific brings the total number of locomotives of this same basic design to 60, all of which have been built by the Montreal Locomotive Works. These new locomotives and their predecessors of the same type are used in comparatively high-speed service on various divisions of the system, one run being between Fort William, Ont., and Toronto, a distance of 813 miles, and another run between Winnipeg, Man., and Calgary, Alta., a distance of 832 miles.

The first of these Hudson-type locomotives, known as the Class H1a, 2,800 series, were built in 1929. One lot of 10 was built in that year and 10 additional built in 1930. These 20 locomotives were of conventional design. The H1b class, comprising the second group of 10, were described in the *Railway Mechanical Engineer,* April, 1931, page 167. In 1937, 30 locomotives, known as the H1c class, were delivered to the Canadian Pacific. These were followed in 1938 by the H1d class which is described in this article. Both of these latter two classes, comprising a total of 40 locomotives, are semi-streamline. With this exception and the fact that 12 out of the 60 locomotives are equipped with boosters no major differences in design exist.

On these most recent locomotives, the shrouding has been designed to simplify the general external appearance and to effect a more satisfactory lifting of smoke. While the boilers are of the conical type, the planished-steel jacket is cylindrical in form around the barrel of the boiler, resulting in straight boiler lines from the front end to the front of the firebox. The piping and fittings, wherever possible, have been concealed under the jacket. The feed-water heater has been lowered in order to reduce the prominence of its projection. A streamline cowl around the stack embodies the number plates and also conceals the whistle. The pilot and front-end shrouding is of plate construction, extending across the whole front of the locomotive. The smoke-box front is plain in design and the headlight is set into the front with the lens flush with the contour of the front. Access to the front is through a removable center section.

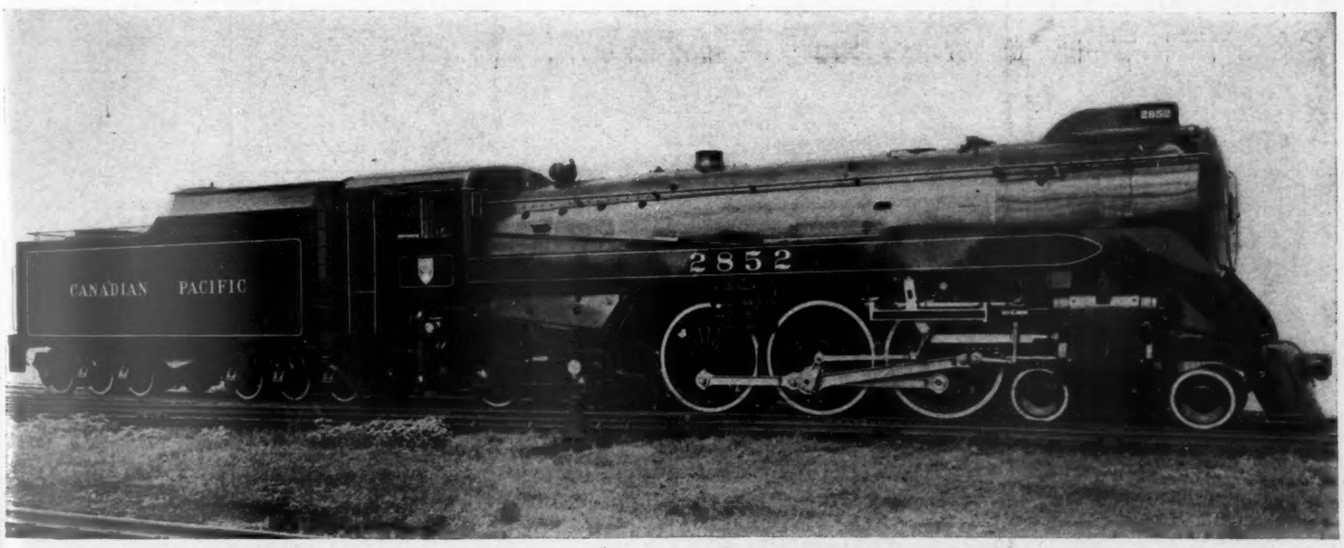
The Boiler

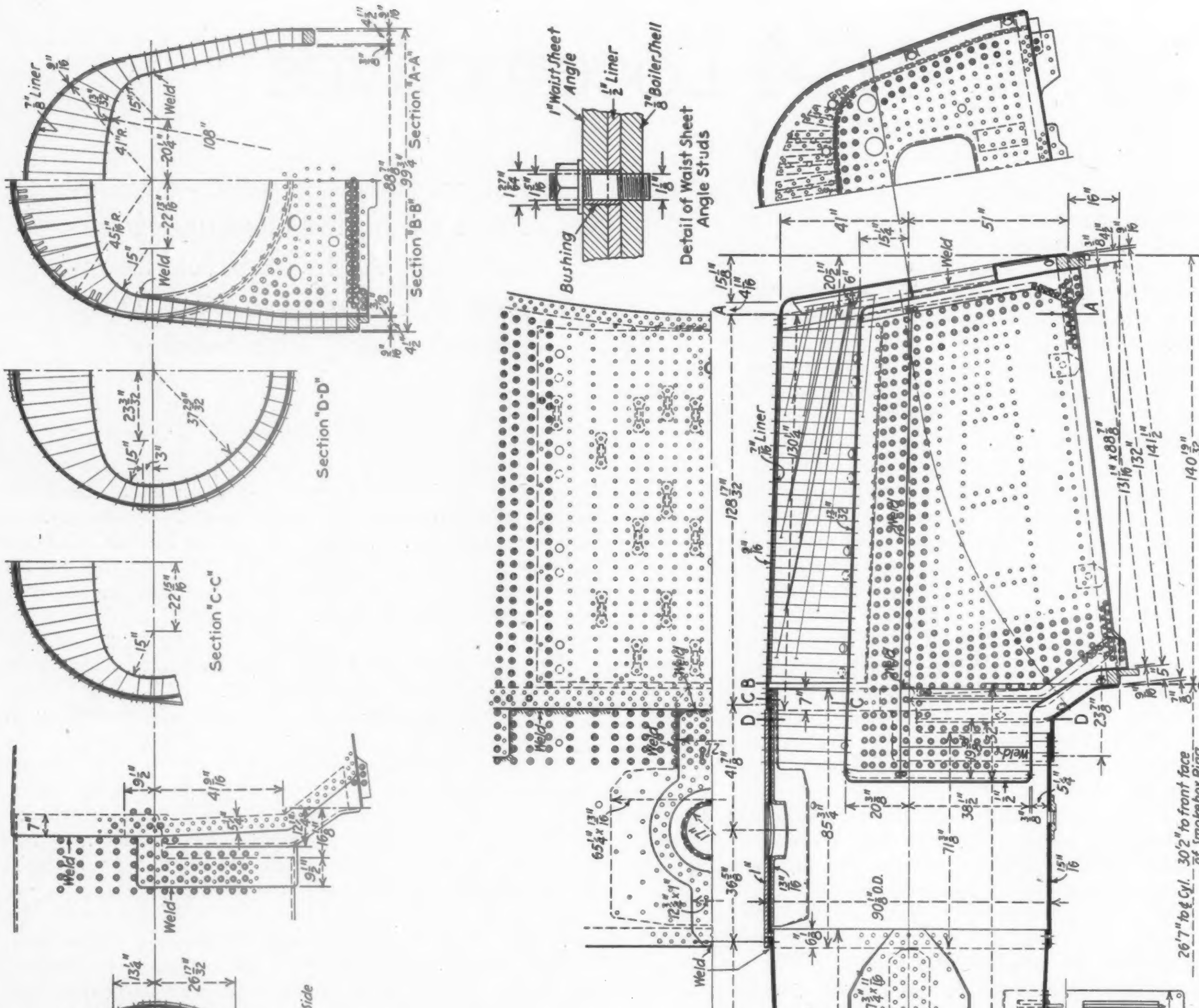
The boilers on these locomotives are of the conical type, built in three courses with combustion chamber. An unusual feature of the design is that the steam dome has been omitted. Steam enters an internal drypipe through a series of serrations at the rear end of the pipe. These openings are milled channels $\frac{5}{16}$-in. wide separated by $\frac{3}{8}$-in. bridges. There are 65 of these openings in the top of the drypipe extending over a length of 3 ft. $8\frac{11}{16}$-in. The projected length of each opening, across the pipe, is about $4\frac{1}{2}$ in.

All of the plates in the boilers, with the exception of the wrapper sheet and liners, are of nickel steel. The thicknesses are as follows: first course, $\frac{13}{16}$ in.; second course, $\frac{7}{8}$ in.; third course, $\frac{15}{16}$ in.; crown sheet, $\frac{13}{32}$ in.; side and door sheets, $\frac{3}{8}$ in.; wrapper and inside throat sheet, $\frac{9}{16}$ in.; outside throat sheet, $\frac{7}{8}$ in.; back head, $\frac{9}{16}$ in.; combustion chamber, $\frac{3}{8}$ in.; front tube sheet, $\frac{5}{8}$ in., and back tube sheet, $\frac{1}{2}$ in.

An extensive installation of Flannery-type flexible staybolts is used in the breaking zones of the firebox. Flexible stays are also used in the combustion chamber except for 16 rows on the bottom where rigid hollow bolts are used. The boilers have Type E superheaters with built-in multiple throttle. The fireboxes are equipped with a brick arch having four $3\frac{1}{2}$-in. arch tubes secured in the throat sheet and back head in arch-tube sleeves.

Other special boiler equipment consists of an Elesco Type H-40 feedwater heater, Type 2-W-60 Hancock Inspirators of 6,250 gal. capacity, Franklin No. 8-A firedoor, Okadee blowoff cocks, and World Consolidated flanged-base safety valves. The grates are of the Rose-





Sectional elevation and cross sections of the C. P. R. 4-6-4 type locomotive boiler

bud type and fuel is fed by a Standard type HT stoker.

The total evaporation of these boilers is estimated at 56,045 lb. per hr., which is approximately 11 per cent greater than the maximum requirements.

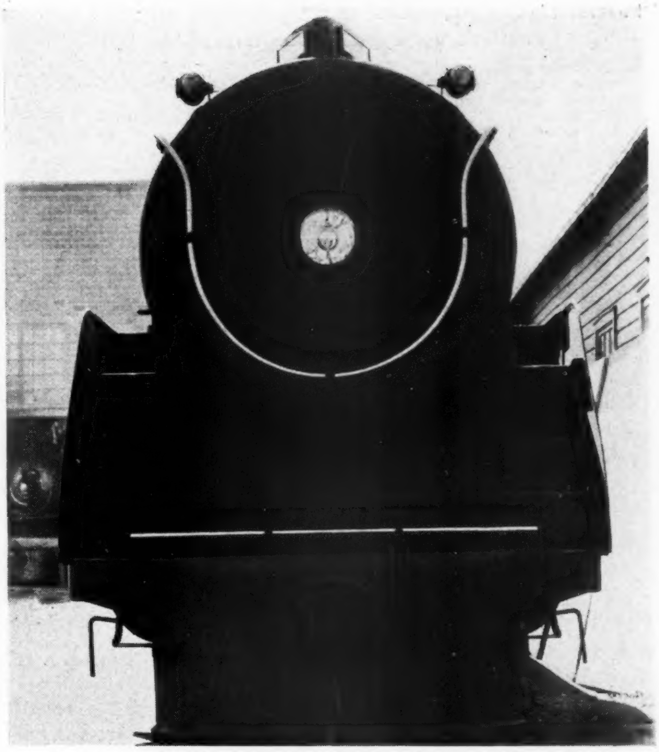
The Running Gear

The foundation of the locomotive is a General Steel Castings Corporation steel-bed casting in which the cylinders and air reservoirs have been cast as an integral part. The engine, trailing, and tender trucks are of Commonwealth design.

With the exception of the engine truck, all of the journals run in plain bearings. SKF roller bearings of the inside-journal type are used on the leading truck. The front and back driving journals are 10½ in. by 14 in. and the main journals are 12 in. by 14 in. The main journals run in Grisco type driving boxes and the front and back driving boxes are of the conventional type. The hub liners are cast bronze and the box crown brasses of nickel bronze. All driving boxes are equipped with Franklin grease lubricators and spreader castings. The driving wheels are of the conventional spoke type mounted on axles with ground journals. The main crank pins are hollow-bored nickel steel.

The wheel diameters are as follows: leading truck, 33 in.; drivers, 75 in.; front trailing truck, 36¼ in., and the rear trailing truck, 45 in. The tender truck wheels are 36¼-in. diameter.

Five of the locomotives of the H1d class are equipped with the Franklin booster driving on the rear trailing-truck axle.



The front end

The cylinders of these locomotives are 22 in. by 30 in. and the piston valves are 12 in. in diameter. Both the cylinders and valve chambers are fitted with cast-iron bushings. The piston heads are of the Z-type, cast steel, with Hunt-Spiller bronze-lipped rings. The piston rods are carbon steel and the Dean type crossheads have a cast nickel-steel body with forged-steel shoes lined with Durite metal wearing surfaces. The guides are forged

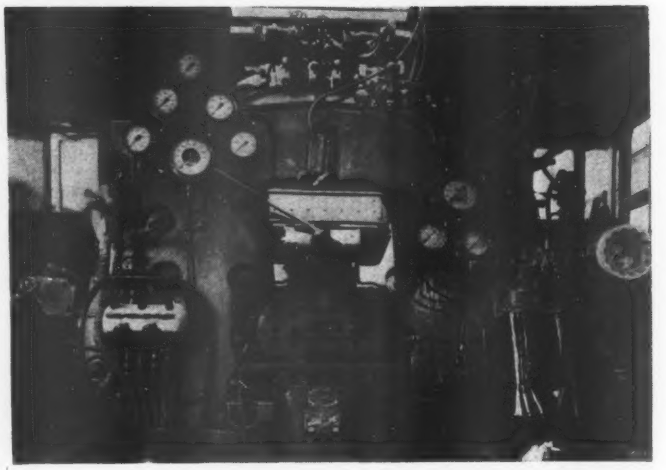
General Dimensions, Weights and Proportions of the Canadian Pacific 4-6-4 Type Locomotive

Railroad	Canadian Pacific
Builder	Montreal Locomotive Works
Type of locomotive	4-6-4
Road class	Hld
Road numbers	2850–2859
Date built	August, 1938
Service	Passenger
Dimensions:	
Height to top of stack, ft.–in.	15–6¹/₁₆
Height to center of boiler, ft.–in.	10–0
Width overall, in.	10–8
Cylinder centers, in.	91
Weights in working order, lb.:	
On drivers	(a) 188,200 (b) 186,700
On front truck	(a) 61,500 (b) 60,500
On trailing truck	(a) 105,700 (b) 115,900
Total engine	(a) 354,000 (b) 363,100
Tender	289,000
Wheel bases, ft.–in.:	
Driving	13–2
Rigid	13–2
Engine, total	39–6
Engine and tender, total	80–6¼
Wheels, diameter outside tires, in.:	
Driving	75
Front truck	33
Trailing truck, front	36¼
Trailing truck, back	45
Engine:	
Cylinders, number, diameter and stroke, in.	2–22 × 30
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7
Steam lap, in.	1⅛
Exhaust clearance, in.	¼
Lead, in.	¼
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	275
Diameter, first ring, inside, in.	78½
Diameter, largest, outside, in.	90⅛
Firebox length, in.	131¹/₁₆
Firebox, width, in.	88⅞
Height mud ring to crown sheet, back, in.	66¼
Height mud ring to crown sheet, front, in.	86⅜
Combustion chamber length, in.	27⅛
Arch tubes, number and diameter, in.	4–3½
Tubes, number and diameter, in.	58–2¼
Flues, number and diameter, in.	171–3½
Length over tube sheets, ft.–in.	18–3
Fuel	Bituminous coal
Grate type	Rosebud
Grate area, sq. ft.	80.8
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	288
Arch tubes	38
Firebox, total	326
Tubes and flues	3,465
Evaporative, total	3,791
Superheat.	1,542
Combined evap. and superheat.	5,333
Tender:	
Type	Rectangular
Water capacity, U. S. gal.	14,400
Fuel capacity, tons	21
Trucks	Six-wheel
Journals, diam. and length, in.	6 × 11
General data, estimated:	
Rated tractive force, engine, 85 per cent, lb.	45,250
Rated tractive force, booster, lb.	12,000
Total rated tractive force, lb.	57,250
Weight proportions:	
Weight on drivers ÷ weight, engine, per cent	51.40
Weight on drivers ÷ tractive force	4.13
Weight of engine ÷ evap. heat. surface	95.80
Weight of engine ÷ comb. heat. surface	68.20
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	6.10
Tube-flue heat. surface, per cent comb. heat. surface	65.00
Superheat. surface, per cent comb. heat. surface	28.90
Firebox heat. surface ÷ grate area	4.03
Tube-flue heat. surface ÷ grate area	42.90
Superheat. surface ÷ grate area	19.10
Comb. heat. surface ÷ grate area	66.00
Evaporat. heat. surface ÷ grate area	46.90
Tractive force ÷ grate area	560.00
Tractive force ÷ evap. heat. surface	11.90
Tractive force ÷ comb. heat. surface	8.50
Tractive force × diam. drivers ÷ comb. heat. surface	636.00

(a) without booster
(b) with booster

Partial List of Materials and Equipment on the Canadian Pacific 4-6-4 Type Locomotives, Class H1d

Main frame with integral cylinders; engine, trailing, and tender trucks	General Steel Castings Corp.
Air brake, engine and tender	Westinghouse Air Brake Co.
Brake shoes	Dominion Brake Shoe Co., Ltd.
Radial buffers (Type E1)	Franklin Railway Supply Co., Inc.
Brick arch	Canada Firebrick Co.
Valves; line checks	T. McAvity & Sons, Ltd.
Gages—steam heat, signal and air-brake	Morrison Railway Supply Corp.
Gages — boiler, stoker; feedwater heater	Sidney Smith. Mulcott Co.
Washout plugs (T-Z)	Consolidated Equipment Co.
Firedoor	Franklin Railway Supply Co., Inc.
Pipe unions—malleable iron	E. M. Dart Mfg. Co.
Pipe unions—forged steel	Crane Co.
Flexible staybolts (Flannery)	Allis-Chalmers Mfg. Co.
Stoker	Standard Stoker Co., Inc.
Superheater; throttle; feedwater heater and pump	The Superheater Company
Injector; main boiler check	T. McAvity & Sons, Ltd.
Air-compressor throttle valve	Westinghouse Air Brake Co.
Cylinder cocks (Okadee)	Railway & Engineering Specialties, Ltd.
Piston rings (Hunt-Spiller)	Joseph Robb & Co.
Packings	The Garlock Packing Company
	Anchor Packing Co.
	Johns-Manville Sales Corp.
Lubrication — motion, brake and spring gear, etc. (Alemite)	The Climax Co.
Lubricators:	
Force feed (Nathan)	Consolidated Equipment Co.
Air-compressor; auxiliary lubricator	Edna Brass Mfg. Co.
Driving-box cellar	Franklin Railway Supply Co., Inc.
Blow-off cocks (Okadee)	Railway & Engineering Specialties, Ltd.
Arch-tube plugs (Huron); back-pressure gage; steam-heat reducing valve (Leslie); cab lamp	T. McAvity & Sons, Ltd.
Electric headlight and generator	Pyle-National. Holden Co., Ltd.
Tender underframe	General Steel Castings Corp.
Draft gear, tender (Miner P-5-XB)	Canadian Appliance Co.
Tender clasp brake	International Equipment Co.
Tank-hose couplings (T-Z)	Consolidated Equipment Co.
Steam-heat couplings	Vapor Car Heating Co., Inc.
Flexible couplings—steam-heat connection between engine and tender; steam-heat connection rear of tender; steam line for stoker; hose for air line (Barco)	Holden Co., Ltd.



Arrangement of cab interior

steel with the Alco Slidguide attachment. Both the pistons and the valve stems operate in King type packing. The valves are actuated by Walschaert gear, controlled by an air-operated screw reverse gear of Canadian Pacific design.

The main and side rods are forged from high-tensile nickel steel and are of the I-section design. The main crank pins operate in floating bushings running in nickel-cast-iron bushings in both the main and side rods.

The lubrication of the moving and wearing parts is provided for by both forced-feed oil and grease systems. Alemite is used on the motion work (except in the link block), main driving boxes, brake and spring rigging, while the Spee-D system is utilized on the main and side rods and the back end of the eccentric rods. Mechanical oiling by means of a Nathan DV-4 eight-feed lubricator takes care of the cylinders, valves, water pumps, air pumps, guides, and stoker engine. Four-way dividers are used on the guides.

The air-brake equipment is the Westinghouse Schedule No. 8 ET with an 8½-in. cross-compound compressor mounted on a bracket attached to the bed on the right side of the locomotive. The feedwater heater pump is mounted on a similar bracket under the runboards on the opposite side.

A feature of these locomotives is a recent design of vestibule-type cab in which the exterior walls are constructed of copper-bearing-steel plate and the interior walls and roof of No. 18- and 20-gage copper-bearing-steel sheet. Johns-Manville 1-in. insulation is used between the inner and outer walls. The flooring is of 2-in. white pine.

The Tenders

The tenders are of the rectangular type with the General Steel Castings Corporation's water-bottom underframes and riveted tank construction. The tanks are of copper-bearing steel and have a capacity of 12,000 Imperial gallons (14,400 U. S. gal.) The coal capacity is 21 tons. The tender trucks are the six-wheel type equipped with clasp brakes operated by 10-in. by 14-in. brake cylinders. Barco flexible connections are used on the steam-heat and stoker lines between the engine and tender and on the steam-heat line at the rear of the tender.

The running gear is exposed to view, facilitating inspection. The air compressor is located beneath the runboard on the right side while the feedwater pump is in a similar location on the left side

One of ten auxiliary water cars equipped for service with 2-10-4 type locomotives on the Chicago Great Western

Auxiliary Water Cars Effect Savings

By building 10 auxiliary water cars for use on its Iowa division between Oelwein, Iowa, and Kansas City, Mo., the Chicago Great Western has eliminated an average of three water and coal stops per train over the division. This has resulted in eliminating more than an hour in running time, increasing the train load, savings in fuel and the conversion of one coaling station and four water stations from regular operation to emergency stations. Regular water stops are now confined to the stations where superior water is available, resulting in better locomotive performance. The auxiliary water cars have tanks of 10,000-gal. capacity, and are used in conjunction with 2-10-4 type locomotives having a tender capacity of 14,000 gal. which gives each locomotive a total water capacity of 24,000 gal.

Tank Construction

To build these tanks, the dome of an ordinary tank car was cut off just above the top of the tank. A flat steel plate was then welded on and manhole covers applied similar to those used on the tender. The manholes are 18 in. wide by 48 in. long, and are equipped with a double cover. The height is the same as that of the tenders, so that both tanks may be filled to capacity.

A wooden platform about 78 in. square is built around the manhole and equipped with a ladder on each side, leading down to the original longitudinal running boards. A hand railing of suitable height extends entirely around the tank, and the platform is also equipped with two hand rails, applied as illustrated so that the penstocks may be adjusted to fill the tank with minimum manipulation.

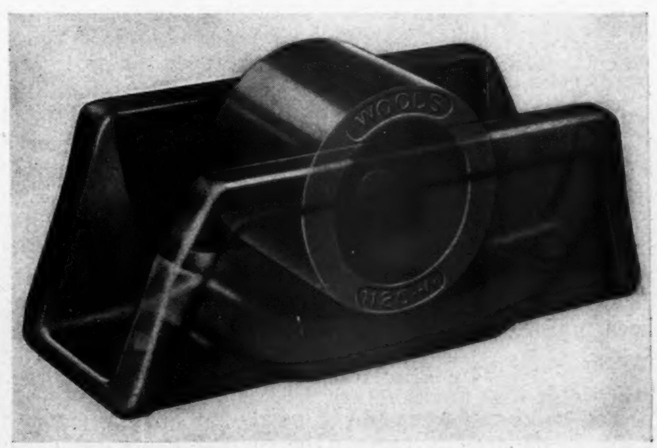
Two splash plates divide the tank into three equal compartments to minimize the surging of water. Only one end of the tank is provided with water piping. The water connection consists of a 4-in. valve on the bottom of the auxiliary tank, another 4-in. valve on the bottom of the rear end of the tender, a 4-in., 45-deg. ell on the tank, a 45-deg. T-Z hose connection on the tender, a 4-in. hose of suitable length and the necessary pipe nipples and clamps. Engine injectors are connected with the primary tank only.

A ¾-in. steam-pipe connection, with the necessary ball joints, leads from the primary tank to the auxiliary tank and discharges directly into the 4-in. water-pipe connection. This heats the water sufficiently to prevent freezing in cold weather. The steam is obtained from the steam line used for heating the head brakeman's cabin on the rear of the tender. Standard coupler connections are used between the auxiliary and the primary tanks, making it unnecessary to increase the length of turntables or other enginehouse facilities, and permitting the convenient interchange of the auxiliary tanks from one locomotive to another.

Roller Side-Bearing Is Improved

Improvements have been made recently in the gravity-centering type of roller side-bearing which Edwin S. Woods & Company, Chicago, has developed to meet A. A. R. specifications and which has been applied in the past few years to thousands of railroad freight cars of all types.

The rolled-steel, heat-treated roller formerly used in



Improved Woods forged-steel roller side bearing

this side bearing has been replaced by a forged-steel roller which provides additional strength, and, together with a forged-steel housing of strong but lighter design, reduces the weight of the bearing by 20 lb. per car set. The new roller, with a 4-in. outer diameter and 3-in.

face, has equalized metal sections, by virtue of the web and rim construction, illustrated, which permit more uniform heat treatment throughout. The rim of the roller is ¾ in. thick and the web is of the same thickness, thus assuring equal heat penetration and uniform strength in all parts of the roller. The heat treatment provided gives a hardness of 320 Brinnell with S. A. E. 1050 steel. Each roller weighs 2½ lb. less than the earlier design.

The forged-steel roller housing of the same general design as formerly employed, is made of S. A. E. 1060 steel, heat treated to a hardness of 310-320 Brinnell, and has the side-wall thickness reduced from ½ in. to 7/16 in., which saves another 2½ lb. per housing. The roller is centered by gravity, as in the earlier design. Minimum clearance is provided between the housing side walls and the roller, thus assuring a true position of roller at all times. The roller-stops, at the limit of travel, are of the same contour as the roller and contact it through one-quarter of its circumference. The slight slippage which occurs at the end of the travel causes the roller to return to the center in a new position.

Recent tests of the new side-bearing, conducted by an independent physical testing laboratory, indicate that it has been designed with a large factor of safety. The roller was tested between two hardened-steel plates under a load of 300,000 lb., the maximum pressure which could be exerted in the testing machine. It is reported that with this load, far in excess of any pressure encountered under the most severe service conditions, the roller showed no evidence of distress or prospective failure, the outer diameter of 4 in. being reduced only .05 in. at the line of contact with the hardened-steel plates.

The Burlington's "General Pershing"

(*Continued from page 174*)

speed and the Decelostat mechanism returns to its normal position, breaking the electric contact and de-energizing the magnet. The Decelostat valve then operates automatically to restore brake-cylinder pressure to the original value.

A lamp is placed in the operator's cab which lights when any Decelostat in the train operates, thus providing a visual indication to the engineman that he is braking up to the adhesion point of the rails.

Prior to being placed in service, the new General Pershing train was subjected to extensive brake tests by the railroad. These tests have demonstrated the general reliability and satisfactory performance of the new braking equipment. For instance, a stop from a speed of 91 m.p.h. was made in 35 sec. and a distance of 2,415 ft. A subsequent stop from 100 m.p.h. is reported to have been made in 46 sec. and a distance of 3,157 ft.

The Traction Power Plant

The traction power plant is installed in a 26-ft. engine-room in the leading unit of the train. It is a standard 12-cylinder, 1,000-hp. Diesel-electric power plant built and installed by the Electro-Motive Corporation, a subsidiary of General Motors. The Electro-Motive Corporation also built the one-piece welded molybdenum-steel front section of the underframe and the all-welded alloy-steel six-wheel power truck. This truck is equipped with Hyatt roller bearings, and the bearings are nominally 6 in. by 11 in.

The Interior Decorations

The interior decorations of the passenger-carrying cars are suggestive of the tones of the autumn landscape. In the coaches and lounge the colors are light sandstone, and brown. The seats are upholstered with Massachusetts mohair plush in tones of brown and rust, and the Chase Seamloc carpets are a mahogany-and-rust mixture. The walls and ceiling in the dining room are flesh-tinted light drab, with raisin upholstery on the chairs and a henna rust Seamloc carpet with an insert pattern in sand. Sand drapes with brown stripes are placed at the coach windows. Color is given in the dining room by variegated drapes in tones of red, orange, brown, and tan. A variety of weaves of mohair upholstery in turquoise, chamois, and dark brown on a jade and brown Seamloc carpet are livened by the use of golden-yellow drapes at the windows of the lounge compartment.

An oil portrait of General Pershing, balanced by a companion painting showing a facsimile of the General's signature, and drawings symbolic of his achievements, honors, and integrity are placed on the front walls of the lounge section. These paintings are applied to stainless steel by a new technique developed by Buell Mullen, the artist. The technique includes the backing-on of a protective coating at high temperatures, which gives permanence to the paintings and a peculiar three-dimensional effect.

The styling and colors of the interiors of the passenger-carrying cars in this train were developed by Paul Cret.

Locomotive Slipping Tests - Correction

In the two-part article entitled "Locomotive Slipping Tests" which appeared in the March and April issues, the following corrections should be noted: March issue, page 87 Table III, Main driver crossbalance, A. A. R. Method, last column of table, under locomotive Class M-4-a, the value should appear as minus 51 lb. instead of plus 51 lb. April issue, page 135, second column, paragraph (b) fifth line should read: " . . . the overbalance in itself without reducing reciprocating weight . . ." Page 138, second column, in the equation following the phrase " . . . and the maximum value of X will be", ω was omitted from the denominator in the last fraction which should have read (P^2 minus ω^2). Also, in the equation for the derivation of the value of ω the numerator of the fraction under the last radical of the equation should read (K plus K_{rail})g instead of (K minus K_{rail})g.

* * *

EDITORIALS

The Patron Be Damned!

In the old swashbuckling days when railways held a transportation monopoly against which the public had not yet taken measures to protect itself, the famous statement of Cornelius Vanderbilt in a moment of irritation, "The Public Be Damned!," all too accurately expressed the psychology of railroad officers in dealing with the public they were in business to serve. Then came regulation and public resentment which effectively cured such tactlessness of approach to matters of public relations.

Curiously enough the same underlying premise, of which this famous statement was but an extreme expression, still colors the attitude of far too many responsible railway officers in some matters affecting their patrons. This may be the heritage of three generations of monopoly, during which the railway industry had to give little attention to the wishes of its patrons. Such wishes were quite completely subordinated to the convenience of the railroads in meeting their own needs for a constant increase in operating economy.

The force of competition is now directing attention to the wishes of the patron. This is evident in the marked speeding up of both passenger and freight service and in the attention which has been given to other methods of making both services more attractive, including rate adjustments. The new de luxe high-speed trains, with their luxurious interior appointments and improved riding comfort, are striking bids for new patronage. But with the patronage which seems secure—the traffic on the conventional main-line trains, the commuters and such local travel as still remains—quite a different attitude is evident. Here the old impersonal attitude that the railroad is run for the convenience of its operating department again shows itself.

One of the worst offenses in this respect is the continued attempts at handling passenger trains of conventional equipment of such lengths that rough handling seems inevitable. Such trains are highly effective as measures for operating economy, but when the comfort of a good Pullman berth is offset by the discomfort of violent shocks each time the train starts, the railroad is jeopardizing its own future passenger business and, indeed, is undermining the future of all steam railways as passenger transportation agencies.

Steam locomotives can be built today, and, indeed, some of them are now in service, which will handle from 1,200- to 1,500-ton trains—all the cars that can be heated—on schedules which require top speeds of from 70 to more than 80 m.p.h. Made up of conventional rolling stock, such trains handle a good deal like freight trains. The slack is a great help in starting, but a cause of great annoyance to the patron trying to rest.

When there was no other way to travel but by rail, such conditions were accepted as necessary. Today, railroads compete with the airways and the highways. They can maintain a strong competitive position only by recognizing the fact that the kind of service the patron wants is more important than the kind of service the railroad finds it most convenient to render. This does not necessarily mean a complete sacrifice of operating efficiency. It does mean, however, that operating efficiency must receive secondary consideration. If 1,200- to 1,500-ton passenger trains are essential to operating economy, they must be first equipped with tight-lock couplers and smooth-operating draft gears. And then the motive power must exert sufficient tractive force to start the train without dependence on slack.

Giving first consideration to the patron also implies a marked change in the customary attitude of the railways to their inventory of motive power and rolling stock—particularly that in passenger service. Such accumulations of obsolescence as are at the present time burdening the railroads are extremely dangerous in a competitive industry. As improvements in rolling stock take place, the railroads can no longer disregard them for years awaiting the wearing out of existing equipment. To do so will be to risk a loss of market to other more progressive transportation agencies.

Locomotive Availability Versus Utilization

The vast difference between potential locomotive availability and actual utilization apparently is not always fully appreciated and, as a result, erroneous conclusions may be drawn in comparing the relative merits of various types of motive power and rolling stock. Availability is ordinarily considered to be the percentage of monthly or annual time which any given piece of equipment is ready for service, excluding all time required for heavy repairs, light repairs and current conditioning and servicing work necessary for the satisfactory operation of the equipment. Utilization, on the other hand, represents the percentage of time which equipment is actually operated in useful service and depends upon service requirements, operating schedules and various factors other than the mechanical condition of the equipment.

In discussing this subject at a recent meeting of the Western Railway Club in Chicago, A. A. Raymond, superintendent of fuel and locomotive performance,

New York Central, said "I should like to differentiate clearly between utilization and availability. That is, a locomotive may be available but if the work is not there we can't take advantage of that availability. In other words, utilization is using as much as possible of the potential availability. From a railroad standpoint, it seems to me that that really is the only important item. Availability is no good if it is resting in the bank. Availability is of value to railroads only as it is used."

Extremely high records of availability up to 98 per cent have been established for certain types of relatively new Diesel motive power, for example, thus demonstrating in a most effective way the general efficiency and reliability of the design, also the well-known advantages of Diesel power in quick turn-around and minimum detention for terminal conditioning and servicing operations. In switching service, it is probable that Diesel locomotive utilization closely approaches the high percentage availability, mentioned, at least in yards and territories where the work can be organized on a three-shift basis. In this intensive use it is customary to secure fuel, water and oil supplies during the crew's 20-min. lunch periods and hold the Diesel switching power out of service for only one 8-hour shift each month for federal inspection and necessary mechanical attention. It is possible also, in a limited number of cases, to organize steam-switching service for a high degree utilization by special arrangements to furnish coal and water and dispose of ashes without sending locomotives to the enginehouse, the locomotives in this case being operated continuously for 30 calendar days, with only one day off a month for boiler washing and federal inspection at the enginehouse. This means a utilization of about 96.8 per cent.

In road service, the possibilities for continuous use of motive power of any type are greatly reduced. Even in such favorable operations as the 1,000-mile daily run of Diesel-powered passenger trains between Chicago and Denver, Colo., where equipment performance reaches the enviable record of 30,000 miles a month, there is a layover of 8 hr. each day at the end of the run which gives a utilization of only about 67 per cent. To cite one other example, the schedule recently announced for one of the new Diesel-powered streamliners calls for a daily round trip of 558 miles between two important industrial centers, the total round trip being made in 10 hr. running time and therefore representing a utilization of only 41.7 per cent. Undoubtedly, every effort will be made to find some means of extending the daily mileage and service hours of this valuable piece of equipment which has so much more potential serviceability than can be utilized in the service mentioned.

Modern steam locomotives also have shown high availabilities up to 93.4 per cent in 18 months' service, but, in the last analysis, it is the average performance of the entire locomotive inventory which produces the largest effect on railroad earnings. Napoleon is reported to have said on one occasion, quoting freely, "We must win engagements by force, but the important question is what we do the *next day* after the battle." In other words, it is the average performance over a period of time which measures the value of any piece of equipment.

As regards steam motive power performance, therefore, some of the figures presented in Mr. Raymond's paper are significant, indicating that, among 13 of the largest railroads in the country, the highest average number of miles per active locomotive day was 254 miles in passenger service, 123 miles in freight service, and 76.8 miles in switching service. At an average speed of 41 miles per hour in passenger service, this means 6.13 working hours, or 25.5 per cent utilization. In freight service, at an average speed of 17 miles per hour the utilization is 7.29 hours, or 30.3 per cent. In switching service at 6 miles per hour, the working time is 12.8 hours a day, or a utilization of 53.3 per cent.

Utilization figures of this low order of magnitude, apply on the best operated roads and represent far better than average performance. It is obvious, therefore, that much remains to be done in analyzing present methods of locomotive use and determining what steps must be taken (1) to reduce the time that locomotives are at terminals; (2) to increase the time they spend earning revenue in road service, and (3) to assure the co-operative effort of all departments, without which these objectives can never be attained.

Horsepower Capacity At High Speed

The report of the Mechanical Division tests to determine the maximum drawbar horsepower required to operate a 1,000-ton passenger train at 100 m. p. h. on level tangent track, an abstract of which appears elsewhere in this issue, presents a wealth of data pertaining to the operation of high-speed passenger trains which merit the careful study of every engineer who has anything to do with locomotive design or passenger-train performance.

One point in the report merits particular attention. In the study of the rates of acceleration based on a set of calculated drawbar horsepower curves, the maximum drawbar horsepower of the entire set of curves, ranging from 3,000 to 7,000 hp. is calculated at approximately 40 m. p. h. This is an extremely low speed at which to reach maximum drawbar capacity in modern steam locomotives designed for high-speed service. The maximum drawbar horsepower of the New York Central J-3 Class 4-6-4 type locomotives, for instance, occurs at 65 m. p. h. A locomotive develops a decidedly higher proportion of its maximum capacity at 90 or 100 m. p. h. if its maximum horsepower capacity is attained at 65 m. p. h. than one which reaches its capacity at 40 m. p. h.

A comparison of these drawbar horsepower curves with that of the New York Central J-3 class 4-6-4 type locomotive, shown on page 173 of the May, 1938, issue of the *Railway Mechanical Engineer*, indicates a con-

siderably different performance during acceleration by the two locomotives of similar maximum capacity. The 4,000-hp. locomotive, which reaches its maximum drawbar output at 40 m. p. h., has greater high-speed acceleration rates up to approximately 55 m. p. h. and less at higher speeds. Hauling a 1,000-ton train, the two locomotives will have reached the same speed of approximately 70 m. p. h. in about five minutes. From that time on the speed of the locomotive which develops its maximum capacity at 65 m. p. h. will accelerate at a higher rate than the other. In about ten minutes it will have accelerated to 90 m. p. h. and will have overtaken and passed the other in point of distance traveled. It will have a balancing speed with a train of this weight of about 5 m. p. h. higher than the other locomotive, even though its maximum horsepower is only 3,880 and the other is 4,000.

From the standpoint of high-speed, high-capacity performance, it is, therefore, evident that it is not alone the maximum horsepower capacity of the locomotive which is important, but also the speed at which it can be utilized. In the final analysis the speed at which maximum capacity is reached depends upon cylinder performance, and as the speed at which maximum drawbar horsepower is reached becomes higher, the demands on the cylinders become increasingly severe because of the accelerating rate at which head-end resistance uses up cylinder horsepower. The speed range within which an increasing cylinder horsepower may be obtained is limited, in part at least, by the difficulty of getting steam into and out of the cylinders at high piston speeds. Improvement at this point would do much for the future of the steam locomotive as a high-capacity, high-speed motive-power unit.

Value of Free Oil?

At the March meeting of the Northwest Carmen's Association, the subject of waste reclamation and general lubrication practice for freight equipment was presented at some length. In the discussion following the main paper, it is interesting to note that, in response to the suggestion that the addition of free oil does little good except when of a lighter grade, one member said, "As I understand it, the main objection to free oiling is that it cannot be supervised. From my standpoint, I feel that every box packer is interested enough in getting cars to destination so that he does not overload the boxes. Further, I feel that, with certain grades of packing, the free oil does a great deal of good in the initial 25 miles of operation after cars have stood for some time at a terminal. I do not mean that free oil should be applied without proper spooning of the box, but I mean that with proper supervision good results have been achieved. I would not say that the cut-back oil disappears from the packing, but it has a tendency to mix with the other oil in the packing and I feel that the box is in a better condition when given to someone else, than it was when originally received. I do not believe every journal should receive free oil, but if we have 20 cars in a train which need journal attention, it is beyond human effort to repack these journal boxes before the train is ready to depart."

This comment by one of the speakers at the Northwest Carmen's meeting is worth consideration as having a very definite bearing on the satisfactory use of free oil in journal boxes. While primarily applied to facilitate train starting under severe winter temperatures, the light oil remains in the boxes during summer operation and consequently presents more or less of a year-round problem to car men. Two questions are suggested: Should the practice of free oiling be permitted at any time? If permitted, is it necessary to repack the boxes in order to assure adequate oil film strength for summer operation?

New Books

Locomotive Management—Cleaning—Driving—Maintenance.—*Seventh edition. Revised by Chas. S. Lake, M. I. Mech. E., M. I. Locomotive E. Published by the St. Margaret's Technical Press Limited, 33 Tothill street, Westminster, London, S.W. 1, England. 492 pages, 5 in. by 8½ in. Price, 6/–, net.*

Much of the text in this seventh edition of Locomotive Management, by Jas. T. Hodgson, M. I. Mech Eng., and the late John Williams, formerly locomotive inspector, Great Central Railway, has been rewritten and much new data, with illustrations, added. Booster engines, boiler fittings of various kinds, anti-friction bearings for axle boxes and valve motions, and other improved features pertaining to British locomotive design, construction, operation and maintenance, are dealt with for the first time in this volume. Types and classes of locomotives introduced since the last edition are also shown and their principal dimensions given. The chapters on rules and regulations governing the operation of locomotives have been brought up to date, and the appendix has been considerably altered to include descriptive matter and illustrations of special equipment and outline drawings of locomotives giving their principal overall dimensions, weights, etc.

Diesel Engines, Theory and Design. *By Howard E. Degler, M.E., M.S., professor of Mechanical Engineering and Chairman of the Department, University of Texas. Published by the American Technical Society, Chicago. 270 pages, 5½ in. by 8½ in., illustrated. Price, $2.50.*

The book is a practical text on the efficiency of internal-combustion engines; thermodynamics of internal-combustion cycles; fuels, combustion, and combustion chambers: testing and performance; principles of engine design, and design of major engine parts as used in the automobile, airplane, tractor, etc. It is intended primarily for the use of students, designers, and draftsmen who have a knowledge of the principles of mechanics and a general acquaintance with the mechanism of some form of internal-combustion engine.

With the Car Foremen and Inspectors

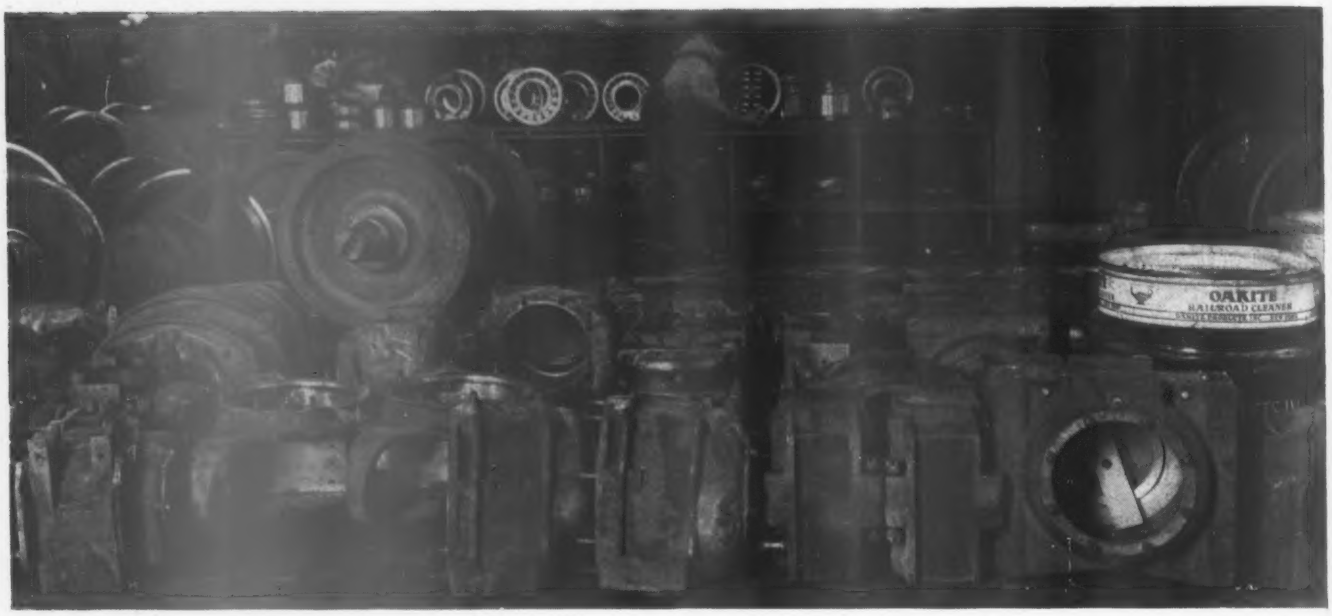


Fig. 1—Roller-bearing repair department in the U. P. passenger truck shop at Omaha, Neb.

Omaha Shop Methods for

Roller-Bearing Repairs

With the increasing number of roller bearings applied to the journals of both locomotive and car equipment in recent years, the importance of developing proper methods of inspecting and maintaining these anti-friction bearings is at once apparent. The present article will be confined primarily to a brief description of how the roller bearings on passenger car journals are reconditioned at the Union Pacific passenger car truck shop, Omaha, Neb.

When trucks received at the shop are in need of general repairs, including wheel changes due to tire wear, thin flanges, etc., the wheels, with roller-bearing boxes in place, are removed and placed with the shop crane on a track in one corner of the shop where the work on roller-bearing wheels and journal boxes is concentrated.

The first operation is to remove the inner enclosure bolts and slide the housings off the roller bearings. The housings, or journal boxes, are cleaned in a hot bath of Oakite solution in a tank outside the shop, then being returned to the shop, wiped dry and carefully inspected inside and out for evidence of cracks, or defects of any kind, which would necessitate renewal of the box. A circular gage, made of thin sheet steel, ground to the exact outside diameter of the roller-bearing cup, is then applied in the box to check the accuracy of the cup bearing surface. This is highly important, as more than one instance of excessive heating of a roller bearing has been traced to a slight distortion in the steel box due to aging, or other cause. A group of roller-bearing boxes, or housings, as they are more accurately termed, is shown in the foreground of Fig. 1, after they have been thoroughly cleaned, inspected and approved for re-application.

Removal of the locking key and large end nut used with the SKF-type bearing usually enables the complete roller-bearing unit to be slipped off the journal. In the case of the Timken bearing the taper sleeve under the outer cone must be pulled out by mechanical power, generally applied by means of a special split sleeve and pulling nut. The outer cone and the double cup are then removed and, in conventional practice, the enclosure, enclosure sleeve and the inner cone are forced off when the car wheel is removed in the wheel press.

Roller Bearing Puller Saves Time

A special roller-bearing puller, now used in removing both the outer and the inner cones of Timken roller bearings at Omaha shops, not only reduces manual labor and saves time in this operation, but avoids the necessity of pressing off the wheel in order to remove the inner cone. An excellent view of this device, set up to pull the taper sleeve which releases the outer cone, is shown

in Fig. 2, and a reverse view with attachments necessary for pulling the enclosure, enclosure sleeve and inner cone is shown in Fig. 3.

Referring to Fig. 2, the puller will be seen to consist essentially of a Duff-Norton 100-ton air jack, mounted horizontally between two heavy steel end plates *A B* bolted (through suitable welded cross angles) to bottom tie plates *T T* which can be adjusted vertically a small amount by screw connection to the frame *F* of the three-cone to be removed by the puller, equipped with another special split yoke *D*, as shown in Fig. 3. In this instance the split yoke, 4½ in. wide by 19 in. in outside diameter, is made in two parts which are recessed on the interior so that it can be readily applied around the enclosure plate and the two halves bolted together by four short ⅞-in. bolts. Four 1¼-in. by 18-in. studs are screwed into the split yoke and extend through suitable holes in end plate *B*, spacing collars and nuts being

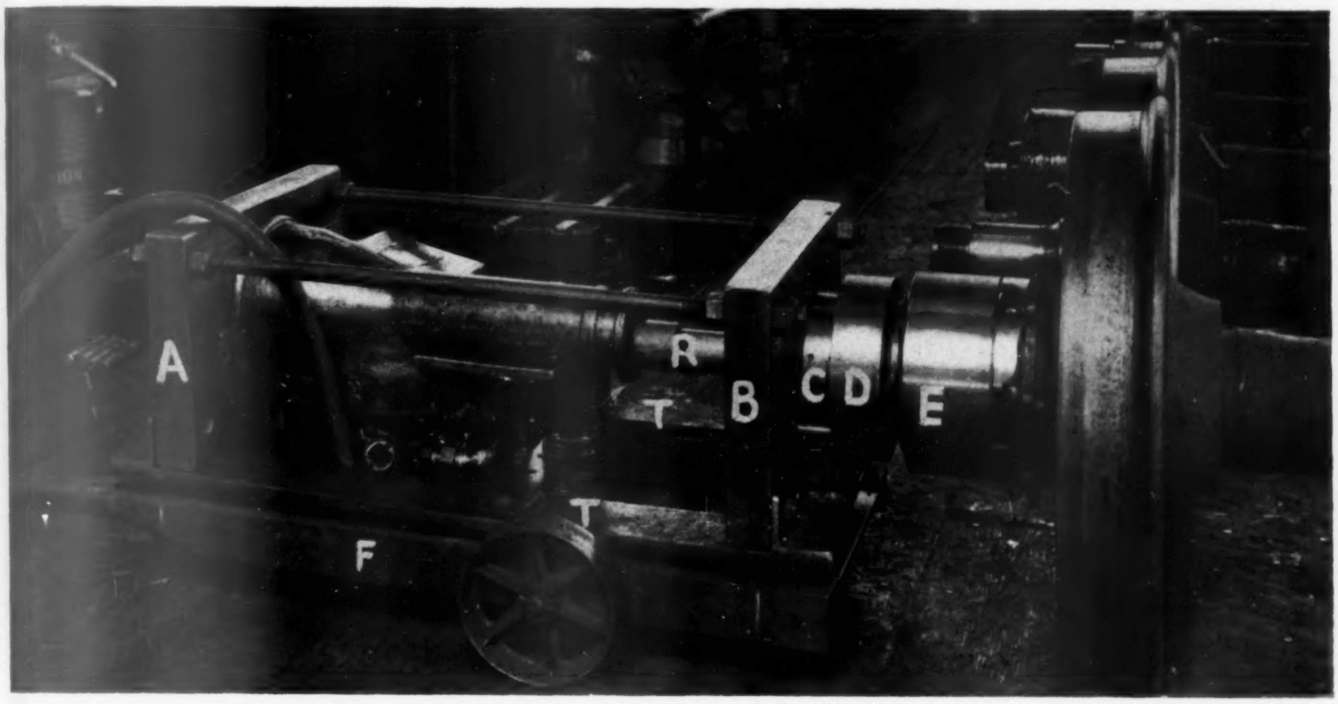


Fig. 2 — Roller-bearing puller, set up to remove the Timken taper sleeve which releases the outer cone and the double cup

wheel truck provided for purposes of easy portability. The end plates, 3 in. by 16 in. by 24 in., are spaced 42 in. apart and held together at the top by two 1¼-in. tie rods. The base of the jack is supported on a half-round flange welded to end plate *A*, as shown, the other support for the jack being a cross strap, welded to tie bars *T T*. The jack head is lightly bolted to this cross strap so as to hold the jack permanently in the correct horizontal position. The end plate *B* has a 3-in. hole in the center which carries a close-fitting round steel ram *R*, about 15 in. long, used in transmitting the pressure of the jack to the end of the car axle.

This horizontal-acting air-jack press must, of course, be adjusted vertically by means of the positioning screws to bring the center line of the ram in exact alinement with the center line of the axle. A threaded split bushing *C*, 5½ in. long by 8 in. in outside diameter, is then applied over the shoulder on the roller-bearing sleeve and locked by means of pulling nut *D*, 3 in. wide by 12 in. in diameter, which is tightened with a spanner wrench. The nut *D* is drilled and tapped on the side for two 1¼-in. by 8-in. studs which project through end plate *B* and are held by suitable nuts applied on the ends. The operation of the air jack, therefore, has the effect of pushing against the end of the axle while the entire pulling device, including the end plate *B*, split bushing *C* and holding nut *D* move to the left, pulling the Timken taper sleeve out and releasing the outer cone. The Timken double cup *E* can then also be easily slipped off by hand.

The removal of the outer cone and the double cup then leaves the enclosure, enclosure sleeve and the inner applied on the ends in preparation for the pulling operation, as illustrated. With the press adjusted both horizontally and vertically so that ram *R* is in alinement with the center line of the car axle, operation of the air jack again has the effect of pushing against the end of the car axle while end plate *B* split yoke *D*, the enclosure, enclosure sleeve and inner cone are being pulled from axle.

By the use of the puller, illustrated, both cones of the Timken roller-bearing unit can be removed much quicker than by any other means, and with manual labor reduced to a minimum.

The Operations of Cleaning and Inspecting

As soon as the roller bearings have been removed and disassembled, they are taken to the cleaning table shown in Fig. 4, where two shallow welded-steel pans are provided for the cleaning operation which is done with distillate. Obviously-defective bearings are detected in the early stages of cleaning and sent to the test department where complete records are kept and an effort is made to determine the real cause of the failure and locate the responsibility.

After cleaning, all roller bearings are sent to the inspection bench, shown in the background of Fig. 1, where the cups, cones, races and all individual rollers are examined with great care. In the case of the SKF-type bearing, the roller assembly can be turned through 90 deg., exposing almost the entire outer race for inspection purposes. The tapered rollers in the Timken bearings are readily removable in case their appearance indicates the desirability of a careful inspection of the races. Roller

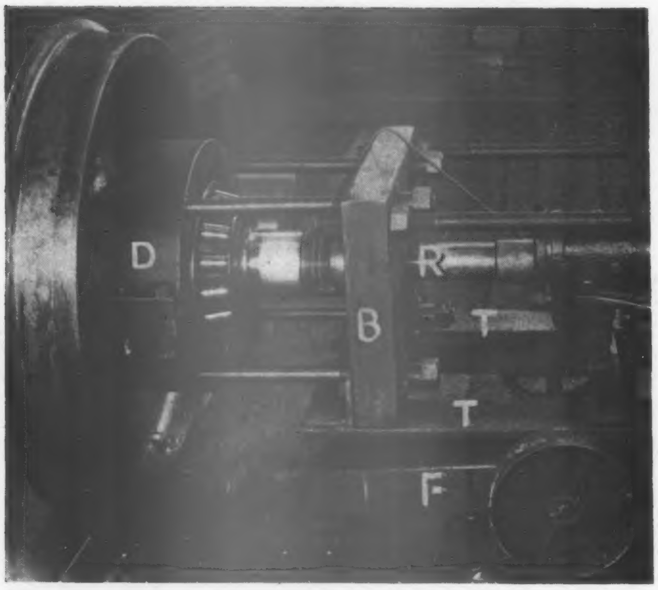


Fig. 3 — Close-up view showing the puller, as equipped to remove the Timken inner cone without pressing off the car wheel

bearings which are in good condition are set aside for reapplication and all defective units replaced by new ones received from the respective manufacturers.

In re-applying SKF-type roller bearings, the dust flinger is put on over the axle next to the hub; the back cover of the box is next applied and the spacer shrunk on by heating to 300 deg. F. in an oil bath which is kept exactly at that temperature, with frequent checks by a thermometer. In some applications, as for instance the engine truck roller bearings shown in Fig. 5, the roller bearing unit itself is heated in the oil bath to 300 deg. F. and applied over the journal with a very light shrink fit. In most instances, with car journals, however, the roller bearing is applied on the journal and a taper sleeve inserted which is tightened by means of the end nut on

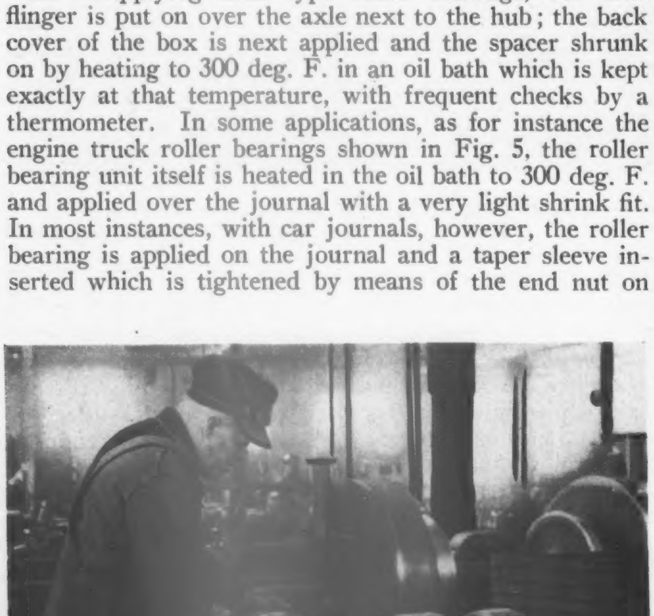


Fig. 4 — Welded steel table and shallow pans used in cleaning all types of roller bearings with distillate

the axle until the desired clearance of 0.0025 in. to 0.0004 in. is provided between the bottom roller and the outer race. The nut is locked in this position by means of a key and two cap screws with the heads wired together. The journal box or housing is then slipped over the roller bearing, with new gaskets in place, the front and back covers applied, nuts tightened on the studs and the box filled with oil to the proper level.

Re-application in the case of the Timken bearings consists of starting the water guard on its seat on the enclosure and placing the enclosure next to the wheel hub on the axle, the bore of the enclosure sleeve being given a coat of clean light oil, as is the bore of the inner cone, next applied. A crowned steel centering plate and cast iron assembly sleeve, guided by a brass pilot sleeve on the outer end of the axle are then applied and the press ram used to force the inner Timken cone and associated parts on with a pressure of 8 to 10 tons. The pilot sleeve is very slightly smaller than the bearing bore and a loose fit on the axle stub. The assembly sleeve is a loose fit on the bearing seat. The centering plate is crowned to equalize the pressure around the edge of the cone, which

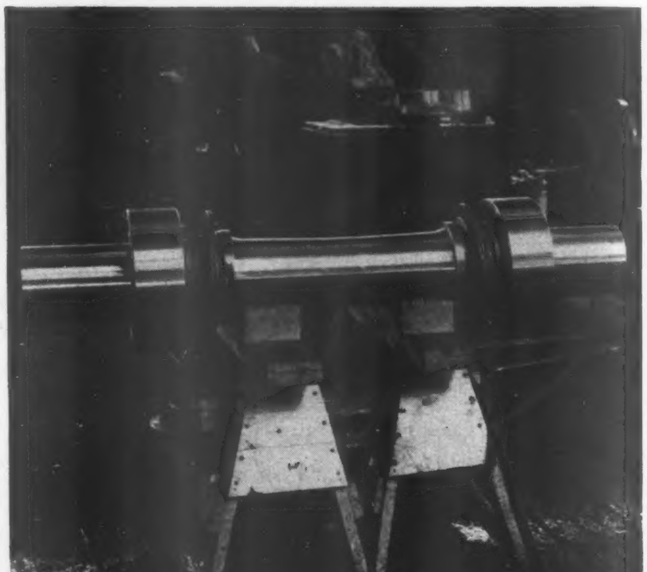


Fig. 5 — Engine truck axle just after the application of SKF roller bearings which have been expanded slightly in the 300-deg. F. oil bath shown in the background

is seated firmly against the shoulder of the axle and square with the bearing seat so that it runs true with the center line of the axle.

The next operation is to apply shims, cone spacer, double cup, outer cone, tapered sleeve and then tighten the axle nut firmly, by hand only. Both the inside and outside of the tapered sleeve is given a coating of clean light oil before being put in place. The lower edge of the cup is then pushed toward the wheel by hand as far as it will go and the clearance measured between the bottom roll and the outer race of the cup by means of feeler gages. The shims are changed until about 0.007-in. clearance is obtained between the bottom rolls and the cup. The diameter of the outer cone is measured with micrometer calipers and the nut tightened so as to expand the cone between 0.0015 in. and 0.0035 in. The remaining clearance at the bottom of the rolls is then checked and adjustments made until it is between 0.0015 in. and 0.0020 in., the cup then rotating freely by hand without noticeable end play. Care is taken in measuring

the cone expansion to apply the micrometer at the same two spots on the cone rib for each reading. The axle nut is locked in place by a fastening key with two bolts, the heads of which are wired sealed.

The housing is applied over the bearing and the enclosure gasket placed between the box and the enclosure flange, all bolts being tightened. The outer cover and gasket are then applied and all bolts tightened enough to prevent leakage of oil, the heads being wire-laced so that they cannot loosen or work off. The water guard is pressed firmly against the wheel hub with a bar, until it has a full bearing all around. One quart of oil is added to the box which is spun through several revolutions to make sure that all parts of the roller bearing are thoroughly lubricated. The car wheels and axle, with a reconditioned roller bearing and box on each journal are then ready for replacement in the passenger car truck. The last operation is to fill each box to the required level with U. P. specification oil, tighten the oil plug and make sure that both this plug and the drain plug are wire sealed to the nearest bolt head to prevent any possibility of loosening.

Wheel Defects and Failures*

By P. J. Hogan†

The relation of car wheels to railroad economics is one of the most important subjects in the mechanical department and large sums of money are expended annually for the purchase of wheels, payment for labor involved in handling, machining, mounting axles and applying the mounted wheels to cars. Other sums are spent indirectly for inspection on shop tracks and in train yards, switching of equipment for wheel changes, freight claims due to wheel failures which cause delay, thereby missing regular schedules, and damage to equipment and commodity when they are the cause of train accidents. Wheel failures, in addition to contributing to these losses, endanger human life as well.

The car inspector is the custodian of wheels from the time they are placed under cars until they are removed for cause and returned to the wheel shop. It is amazing how quickly he will detect unsafe wheels. His early training in the shop and on the repair tracks and his continual vigilance over them in train yards, together with the use of the A. A. R. wheel defect gage, gives him the necessary qualifications quickly to pass proper judgment as to whether or not the wheel is safe to run.

It is his duty carefully to inspect all wheels for looseness on the axle, limits of wear as required by the A. A. R. rules and all other defects which affect safety.

The A. A. R. rules do not permit railroads to remove from foreign cars and render a bill for any wheels until some defect has reached a definite condemning point and we must consider the wheel safe until that point is reached. When the condemning point is reached the wheel should be removed from service. However, it is no more than reasonable to assume that, if the wheel has only reached the limit point, it is still safe to let it run to the nearest point where it can be changed.

Inspection of wheels is one of the most particular and important jobs a car inspector has, for, if defective wheels were allowed to progress beyond the limits of safety, serious accidents would occur, and yet if they are removed before reaching the limits of wear, the cost to the railroads would be enormous; therefore, the car inspector has to study and know what the wheel defects are and must be on the alert to detect such defects under cars.

Many wheels have inherent defects and are not visible to the eye in ordinary or even in minute inspection, while other defects that exist do not present themselves where they can be readily seen. These classes of defects usually cause train accidents. Many defects develop in ordinary wear and tear, others progress by improper handling in train and yard operation, controlling speeds in mountainous sections of the country, causing wheels to overheat, defective brake equipment, curve-worn rails, worn frogs and other irregular track conditions, weather conditions, etc. These are but some of the causes for wheel defects and failures.

On the road I represent, records for the year 1938 indicate that we changed 7,041 pairs of wheels under freight cars for the following reasons:

Brake burns and comby treads	1,064
Chipped or broken flanges	364
Worn flanges	347
Loose wheels on axle or oil indications	92
Hub or plate cracks	57
Broken wheel rims	1,817
Seamy treads	1,314
Worn thru chill	1,001
Shelled out treads	175
Tread worn hollow	268
Thermal cracked	12
Wheels slid flat	530

During the same period we changed 3,598 pair of wrought- and cast-steel multiple-wear wheels under passenger cars for the following reasons:

Brake burns	2
Chipped or broken flanges	1
Worn flanges	1,879
Wheels loose on axle or oil indications	28
Burned rim	1
Shelled treads	185
Worn out rims	163
Tread worn hollow	574
Thermal cracked	97
Slid flat	573
Miscellaneous	95

I mention these tabulations to bring before you the efficiency of the car inspector in detecting these defective wheels and removing them before causing failure and possible accidents. In this connection, understand all of these wheels did not become defective on the New Haven—many of them were found upon receipt of cars from connections.

The inspector has to be sure of the condemnable or questionably defective wheel so as to avoid sending a foreign empty or loaded car to the repair track with the attendant per diem charges and possible delay to the commodity; accordingly, he should not hesitate to make use of the A. A. R. defect gage.

Defects in Freight-Car Wheels

In considering the defects on the 7,041 pairs of wheels removed from freight cars the following is a discussion of the causes:

* A paper presented at a meeting of the Eastern Car Foremen's Association, New York, April 14, 1939.

† Supervisor Car Inspection and Maintenance, N. Y., N. H. & H.

Brake-Burn Cracks and Comby Treads—Interchange Rule 75 states that cast-iron wheels with comby spots where the metal has fallen out for a continuous length of 2½ in. or over, or two such adjoining spots each 2 in. or over, is condemnable. Brake-burn cracks in cast-iron wheels, when the cracks are in the flange or in the throat of the flange, or in the tread, when over 2¾ in. in length, are condemnable. These brake-burn transverse cracks, regardless of length, are considered as extending into the throat if they come within ⅞ in. from flange and may be determined now by the A. A. R. defect gage, Fig. 1-A. Comby wheels refers to a wheel in which the metal has fallen between the adjacent brake burn spots and, when of the condemning length, makes a comby flat wheel. Brake-burn cracks are a result of excessive heating caused by the brake shoe or by a skid burn; the chilled iron being unable to withstand the localized heating. This condition is dangerous when it is in the flange or throat of the flange. To cause this condition the temperature of the wheel is raised to about 1,400 deg. F. A comby wheel is not dangerous in itself but is damaging to car, lading and track.

Chipped or Broken Flanges—These were caused by contact with guard rails, spring frogs, and other obstructions. Rule 78 provides that the wheel is condemnable when the chip is more than 1½ in. in length and ½ in. wide; such flanges are liable to cause further failure. However, light chips on the flange are not dangerous and such wheels should not be changed.

Thin Worn Flanges—Rule 75 provides limits of wear. Thin worn flanges are measured by the defect gage. This gage has two slots for measuring the flange thickness; one is marked 15/16 in. and is used to condemn flanges on cast-iron wheels under cars of less than 80,000 lb. capacity and all wheels, cast-steel or wrought-steel, regardless of car capacity. The 1-in. slot is used on cast-iron wheels under cars of 80,000-lb. capacity and over.

The vertical worn flange is in no way dangerous except that it may split a switch, otherwise it is perfectly safe to operate. To break a flange on a single-plate cast-iron wheel worn to the condemning limit, takes a pressure of about 66,000 lb. Derailments should not be chargeable to a worn vertical or thin flange unless it has split a switch.

Loose on Axle—For wheels listed as loose on the axle or indicating oil leakage to the inside of the wheel, Rule 81 makes the car owner responsible, except in the case of oil seepage if the wheel is removed within one year from the date of application. To the car inspector, loose-wheel indications are generally oil working through the wheel fit; bright wear on the axle at the wheel fit or the breaking away of the paint seal at this location; a fine burr on the inside of the wheel hub at the wheel fit and distinct marks on the flange by guard rail and frog contacts. This defect will also cause a hot box by wheel crowding. Poor shop practice in wheel mounting is usually the cause of this defect.

Hub and Plate Cracks—Rules 77 and 78. The car inspector's trained eye detects these defects which sometimes show up as a loose wheel when in the hub, and when in the plate they open up considerably with the running heat of the wheel. When the wheel is cold it contracts and the cracks close up tight, consequently the defect cannot be seen. These defects have to be carefully watched on account of liability of failure. The cause of such failures is usually due to foundry practices but they are also chargeable to train handling under certain conditions.

Broken Rims—Rule 78 provides a limit distance from the flange of 3¾ in. for breaks which slope inwardly and a limit of 3½ in. for those which are vertical or slope outwardly. This is a defect that requires proper gaging to prevent unnecessary car shopping. The cause of broken rims is primarily curve-worn rails and wheel-worn frogs, and most of these failures take place on freight railroads where tracks are not maintained for high speed. The outer portion of the tread of cast-iron wheels is not ductile enough to withstand all shocks received on the low rail at times when the opposite wheel is crowded against the curve-worn ball of the rail. Similar breakage occurs also at times when the wheels are passing through worn frogs, and I might mention that there are certain kinds of frogs which have a tendency to damage the wheel rim.

Seamy Treads—Seams defined in Rule 72 are dangerous and should be removed from service upon discovery when they are within the limits of 3¾ in. from flange. Inspectors should take special precautions to discover any indication of seams as they may develop in different parts of the treads.

Worn Through Chill.—Rule 73 provides that care must be taken to distinguish this defect from flat spots caused by sliding, on account of the divided responsibility. This defect is now condemnable by judgment. When developed it leaves a low or flat spot on the wheel tread. It may be determined by drawing a straight-edge over the suspected area which will leave a bow on the outer edge of wheel rim if the chill is worn. In detecting wheels that are wearing through the chill, the inspector discovers the chill lines breaking down and the rim taking a curve line near the outside. He also discovers the flange height increasing. The defect is due to low chill and when the white metal is worn through, the grey soft metal flattens out. It is a manufacturing defect.

Shelled-Out Treads—Rule 71 provides that cast-iron or cast-steel wheels with a shelled-out spot 2½ in. in length or over should be removed from service. This defect is measured circumferentially and not across the tread. It is distinguished from the comby spot by the high center and should be properly named on shop and billing records. Shell-out wheels are not considered dangerous from the viewpoint of wheel safety but they are liable to cause track, car and lading damage.

Tread Worn Hollow—Rule 76 defines the use of the gage for the condemning of cast-iron and one-wear cast-steel wheels when the projection on the under side of this gage clears the wheel tread the flange has exceeded 17/16 in. in height. When the wheel has actually worn to this limit it should be removed as the deep flange is liable to strike the base of frogs and break up.

Thermal Cracks in Tread—Rule 75 provides that such cracks, if in the flange, the throat of the flange or, when in the tread, are over 2¾ in. in length are condemnable. Thermal cracks invariably run at right angles to the tread of a wheel. They are caused by brake-shoe pressure being applied for such a period that the temperature of the tread is raised to about 1,400 deg. F. A stuck air brake or a hand brake set up could cause this condition in a distance of about a half mile. These defects are dangerous when in the flange or throat of the flange. Wheels showing red discoloration should be carefully checked for cracks of this kind.

Slid Flat Wheels—Rule 68 provides that slid flat wheels must not be removed until one spot at least has reached 2½ in. or two adjoining spots each 2 in. in length. These flat spots must be considered as running circumferentially with the tread. When the two adjoining flat spots have developed they must be in contact with each other. The sliding of wheels, in addition to being costly, is very troublesome in train opera-

tion. When wheels slide the co-efficient of friction between the brake shoe and the wheel is greater than that between the wheel and the rail. There are many things which cause wheel sliding. For example, when wheels are out-of-round high speeds reduce the wheel contact weight on the rail and at a critical moment a brake application will slide the wheel. Other causes are wet and greasy rails, improper handling of air brakes, hand brakes set up, shoes frozen to wheels, and wheel and rail head contour variations. In many cases, as a slid flat spot increases in length the friction between the wheel and the rail increases, overcoming that between the wheel and the brake shoe; therefore, the wheel revolves again. In other cases the wheel slides again on the same spot which increases in length and the wheel will continue to slide. To flatten a wheel the temperature has to be raised by friction to about 2,000 deg. F. A 1-in. flat spot develops in a very short distance, depending on the wheel weight and the rail conditions. In many instances only one wheel on the same axle will flatten due to the same cause.

Passenger-Train Wheel Defects

In the case of wrought-steel and multiple-wear cast-steel wheels 3,598 pairs were removed from passenger-train cars. A discussion of the reasons follows:

Brake-Burn Thermal Cracked.—Passenger Rule 7 provides that cast-steel, wrought-steel or steel-tired wheels with thermal cracks in the tread or flange, regardless of length, are condemnable. These cracks are caused by intensive brake-shoe heating; thus, when the heat is sufficiently high and concentrated in the tread surface transverse cracks develop; a brake shoe riding the wheel rim or bearing hard on the flange will cause such defects. They are serious as there is no means of determining the magnitude of the strain in the wheel structure. Inspectors must keep a constant watch for rim heating and all cracks on wheel treads.

Chipped or Broken Flange.—This defect is caused by guard rail and frog contact, also by other obstructions. It also denotes a wheel loose on the axle and a careful check should be made.

Worn Flanges.—Rule 7 provides that wrought-steel, steel-tired or cast-steel wheels with a flange 15/16 in. thick or less, or having a flat vertical surface extending 1 in. or more from the tread, are condemnable. The thickness of worn flanges is determined by the wheel defect gage and it should be properly applied in accordance with Fig. 3 of the Freight Code. Vertical worn flanges are hard to find if properly gaged. The flange should be chalked on the gage side with the end of the gage resting on the wheel tread and the side of the gage against the flange. With a slight movement back and forth the chalk will appear on the bearing point—if the 1 in. point is not reached, the wheel should remain in service.

Wheels Loose on Axle or Oil Seepage.—This defect has been explained under the freight-car wheel removal.

Burned Rim.—This type of defect leaves a rough granular surface on the break, and is generally caused by overheating in the course of manufacture.

Shelled Treads—If the surface metal breaks down, spalls or flakes, it is termed a shelled tread. A cut, to a depth of 3/8 in., should be taken to clear up this defect. If more than 3/8 in. deep, it should be protected and further investigated for other termed defects. We have had only a few that could not be turned.

The 95 wheels removed for miscellaneous causes were for defects found principally in the turning of wheels in the shop.

The above defects, most of which were discovered by the car inspector, further proves that his watchfulness over these wheels has borne fruit in preventing wheel failures. In addition to the A. A. R. defect gage, an inspector must be familiar with other wheel gages to know that wheels are of the proper gage on the axles and to detect tread wear.

The car repairer on the repair and shop tracks selects the mounted wheels for use under cars, checks them for proper weight and kind, takes records for billing purposes, marks up the defects and the symbol numbers on the wheels for ready identification, services the journals and the boxes and sends them on their way. All wheels receive final inspection at the wheel shop.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

426—*Q.—What improvement may be noted for this equipment insofar as brake cylinder pressure is concerned?* A.—Due to the automatic self-lapping feature of relay valves, the brake cylinder pressure developed for a given brake pipe reduction is not affected by varying brake cylinder piston travel or normal brake cylinder leakage.

427—*Q.—How does the D-22-A valve compare in size to the old type?* A.—It is smaller.

428—*Q.—For what reason is the installation space less?* A.—By reason of combining in one structure the volume of emergency, auxiliary and displacement reservoir.

429—*Q.—What conversion feature is of great benefit?* A.—The high-speed conversion feature. The D-22-A valve is so designed that by adding additional available devices to the equipment it can readily be adapted for electro-pneumatic operation with a speed governor or Decelakron control for ultra high-speed service.

430—*Q.—What parts make up the complete D-22-A control valve equipment on a passenger equipment car?* A.—

Quantity	Name
1	D-22-A control valve
1	Combined dirt collector and cut-out cock
3	Branch pipe tees
2	B-3-B conductor's valves
2	E-3 brake application valves
1	Retaining valve
1	Combined auxiliary, emergency and displacement reservoir
1 (or more)	Supply reservoir with drain cock
As required	Relay valve, Type B or A-4-A
As required	Type U brake cylinders
As required	Slack adjusters
As required	Brake cylinder cut-out cocks
As required	Armored hose for brake-cylinder pipes
2	1¼-angle cocks
2	1⅜-in. hose with couplings
2	F dummy couplings

431—*Q.—What does the D-22-A control valve consist of?* A.—Two face pipe brackets, service portion and emergency portion.

432—*Q.—How does the pipe bracket function?* A.—It is bolted to the under framing, all pipe connections being made permanently to the bracket by means of re-

enforced flanged unions. The service and emergency portions are bolted to the bracket.

433—*Q.—What is a desirable feature in connection with this arrangement?* A.—No pipe joints need be disturbed when removing or replacing portions.

434—*Q.—What is the duty of the service portion?* A.—It controls the desired charging of reservoirs and the service application and releases the brakes.

435—*Q.—What improvement can be noted?* A.—Improved quick service transmission, release insuring and graduated release features.

436—*Q.—What is the duty of the emergency portion?* A.—It controls the quick action feature, high emergency brake cylinder pressure, and the accelerated emergency release function.

437—*Q.—What improvement may be noted?* A.—Improved emergency transmission and accelerated release after emergency application.

438—*Q.—What does the pipe bracket contain?* A.—The quick-action chamber, a removable hair strainer and two choke plugs; the latter being located in the service portion face.

439—*Q.—What is the size of the plug opening?* A.—The size choke in each plug varies with the brake cylinder size.

440—*Q.—Why is this?* A.—To provide uniform operation of brakes in train service regardless of the number of sizes of brake cylinders or individual cars.

441—*Q.—What are these plugs called?* A.—Exhaust choke plugs and service port choke plugs.

442—*Q.—What other pipe connections does the pipe bracket have?* A.—The necessary pipe connections for later conversion to high-speed conversion feature.

443—*Q.—How is the blanking flange arranged?* A.—For replacement with a suitable double check valve for HSC service.

444—*Q.—What is meant by the high-speed conversion feature?* A.—By adding additional devices to the equipment it is readily adapted for electro-pneumatic operation with speed governor or Decelakron control for ultra high-speed service, as on light-weight streamline trains.

445—*Q.—Name the parts of the service portion?* A.—Service piston, service graduating valve, service slide valve, service piston return spring and cage, piston tail spring and guides, supply reservoir charging check and ball check, emergency reservoir charging check and ball check, back flow check and ball check, release piston and slide valve, quick service choke plug, duplex release valve, quick service volume, preliminary quick service exhaust choke plug, graduated release choke and quick service limiting portion.

446—*Q.—What is the duty of the service piston?* A.—It moves the service graduating and slide valves when the brake pipe pressure is varied and controls charging of supply, auxiliary and emergency reservoirs from the brake pipe.

447—*Q.—What is the duty of the service graduating valve?* A.—It opens and closes the passage between: (1) Auxiliary reservoir and the chamber on the face of the release piston in release position, or between this chamber and the atmosphere with the slide valve in application position. (2) Atmosphere and quick-service volume in release position, or between this volume and the brake pipe with the graduating valve in preliminary quick service position and (3) Auxiliary reservoir and displacement reservoir with the slide valve in service position.

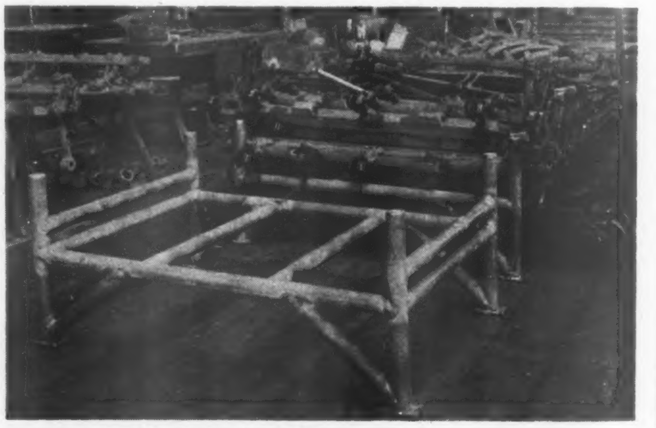
448—*Q.—For what purpose are the piston tail springs and guides?* A.—To provide stability of quick service activity by preventing movement of the service piston to preliminary quick service position until a predetermined difference is attained between the brake pipe and the auxiliary reservoir and to stabilize against movement to preliminary quick service during the graduated release operation.

449—*Q.—What is the purpose of the supply reservoir charging and ball check?* A.—To permit charging flow to supply reservoir from the auxiliary and prevent back flow.

Brake-Beam Skid

The light, but well-braced, tubular steel brake-beam skid, shown in the illustration, is a design recently developed and used with considerable success at the Union Pacific passenger car truck shop, Omaha, Neb. This brake-beam skid, or rack, is constructed of $2\frac{1}{4}$-in. scrap boiler tubes, cut to the proper length and shape and welded into a rigid one-piece frame, as illustrated, using the oxy-acetylene welding torch.

The skid is 56 in. long by 37 in. wide, with corner posts 24 in. high. The tubular frame of the skid is suitably stiffened by the addition of one extra tube, 16 in. above the floor, in each end and two center cross tubes, as illustrated, also by one diagonal tube, or brace, at each corner post. The corner posts rest on $\frac{1}{2}$-in. by 3-in. by 5-in. steel shoes to give a larger bearing surface on the shop floor. The tops of the corner posts are capped with steel plugs, driven into a shoulder and used



Light but strong brake-beam skid used in the Union Pacific passenger car truck shop at Omaha, Neb.

to prevent stacking these skids to a point which might be dangerous. All tube joints are machined either square or to the necessary angle in a lathe, using a rosebit reamer, thus assuring a good fit of the parts before welding.

By being piled in an orderly manner on this skid, the brake beams are easier and safer to handle and there is no chance of their sliding off on the floor, with possible injury to shop men who are handling them. The skid, illustrated, has a capacity for 14 passenger truck brake beams, loaded two deep, or more than enough for a single passenger car. In other words, the skid can be used to hold a full set of brake beams, as removed from two trucks, easily transferred with a lift truck to that part of the shop where necessary repairs are made, and returned with minimum manual labor in handling. The illustration shows an unloaded skid in the foreground and a loaded skid with the lift truck in place immediately adjacent to it.

IN THE BACK SHOP AND ENGINEHOUSE

Railroad Shop Work Requires

Precision Gages*

By J. H. Hahn†

ONE of the most important precision measuring instruments in common use in the United States is the micrometer caliper; in fact, no other precision instrument has been so universally used. History tells us that the micrometer, like many other important inventions, is the product of many minds and hands and has been developed to its present stage by gradual evolution. Evidence now available shows that a French inventor and machinist by the name of Jena Laureut Palmer is given the credit for the origin of the micrometer caliper. Palmer obtained a patent on his "screw caliper," as it was called, on September 7, 1848. The trade did not seem to appreciate this tool until 1867, when it was seen by Joseph R. Brown and Lucian Sharpe while on a visit to the Paris Exposition of that year. The micrometer caliper was placed on the market in the United States in 1869, and is now generally used in most of the machine shops in this country.

The measuring instruments used in the machine shop at Roanoke are carefully checked and corrected, if necessary, at regular intervals to insure the greatest degree of accuracy. In addition to micrometers and steel scales, varying from one inch to twelve feet in length, there are many special measuring instruments in use in the form of gages, trams and special micrometers ranging in size from 1 to 80 in.

The class of work a shop turns out is governed largely by the accuracy of the measuring instruments used

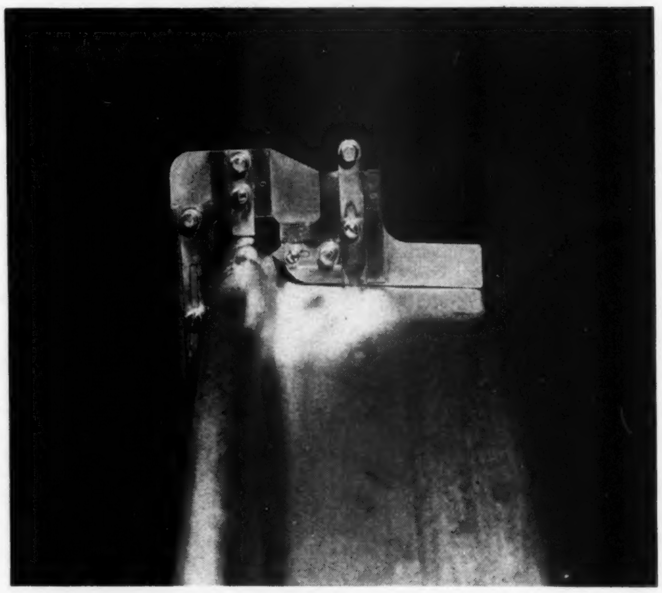


Fig. 1—Gage used for checking driving and trailer tires

and Roanoke Shop is well equipped with all kinds of precision measuring instruments. In the manufacture of special gages and templates, two very efficient and interesting machines are usually employed. One of these

* Reprinted, in part, from the Norfolk & Western Magazine.
† Machine shop foreman, Norfolk & Western, Roanoke, Va.

Fig. 2 (Left)—Nibbling machine used to make special gages and templates. Fig. 3 (Right)—Filing machine for finishing gages and templates

Fig. 4—Assortment of precision instruments and gages used in the tool room

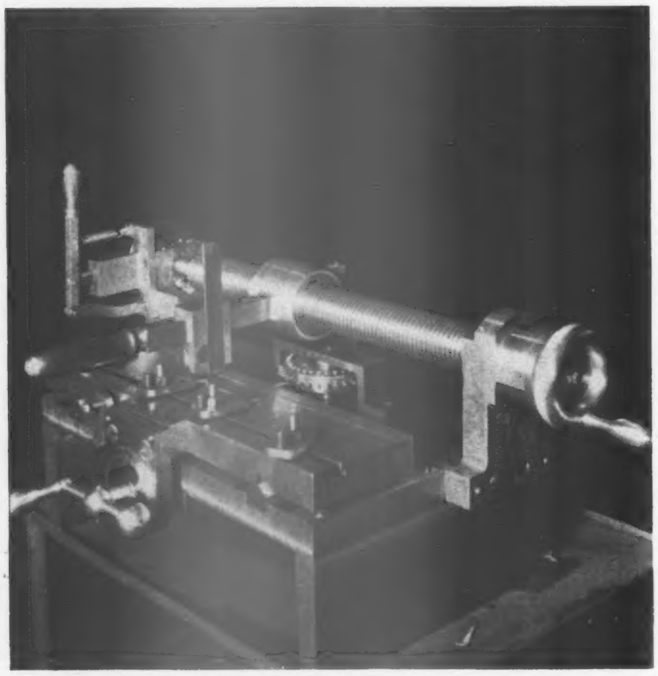


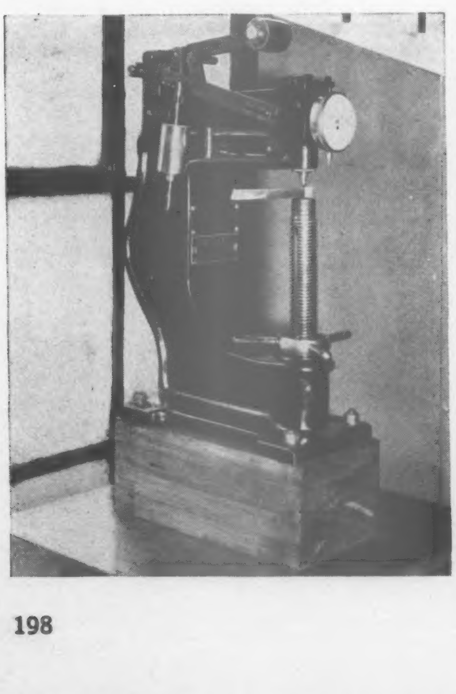
Fig. 5—Special machine used for graduating steel scales

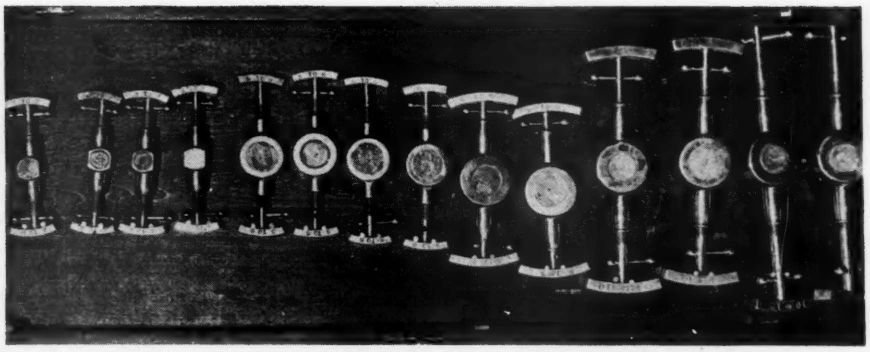
machines, known as a "nibbler," roughs out the gages within close limit of the finished dimensions. This machine is shown in Fig. 2. The semi-finished gages are then placed on a filing machine, shown in Fig. 3, where they are finished. The gages are sand blasted and some of them are chromium plated to protect them from rust.

Fig. 4 shows a set of Johansson gages and other precision measuring instruments in use in the tool room of Roanoke shops for checking the accuracy of all gages, micrometers and other precision measuring instruments. These Johansson gages are the most accurate measuring devices that can be obtained for average shop use. The Johansson gages are accurate within one four-millionth part of an inch (.000004 in.) and are usually adjusted to size at a temperature of 68 deg. F. There are precision measuring instruments in the Bureau of Standards in Washington with which it is possible to measure with a greater degree of accuracy, but for general shop practice such a degree of accuracy is not considered practical or necessary. The Johansson gages can be assembled to form any required dimension. This is done in a very systematic manner and each gage must be absolutely free from any dust or foreign matter.

There are approximately 30,000 different items of

Fig. 6 (Below, left)—Rockwell machine for hardness testing. Fig. 7 (Below, right)—Gage for laying off the keyways in the main crank pins for the eccentric crank arms





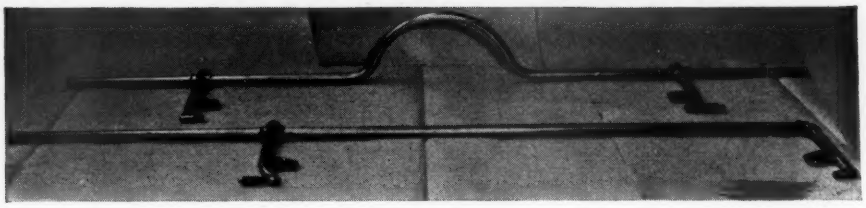


Fig. 8 (Left)—Special tram dial indicator. Fig. 9 (Top right)—Adjustable centers for checking the lengths of main and side rods. Fig. 10 (Lower right)—Micrometer calipers for measuring driving wheel tires

material manufactured annually in Roanoke shops in lots ranging from twelve to several thousand. These items differ greatly in material, design and size. Many require the design, manufacture and use of special gages, templates, jigs, fixtures, precision measuring instruments, check gages and trams to insure the greatest degree of accuracy during the process of manufacture. Everything possible is done to obtain the finest workmanship and the machine shop is well equipped with the necessary machine tools, precision measuring instruments and other facilities for handling the wide range of work that comes to this shop from all points on the road.

A number of special gages and measuring instruments require the use of steel scales of various lengths. These are graduated on a machine, shown in Fig. 5, which was designed and constructed by Norfolk & Western mechanics.

Internal and external thread gages are used for checking threads on all bolts, studs and other threaded parts. All nuts are checked in the same manner to insure proper fits between all threaded parts manufactured in Roanoke shops before being delivered to the stores department.

All trams used for tramming main and side rods, valve gear and other parts are checked at least once each week by a master tram bar for accuracy. A variety of gages are used in the grinding room where all drills, reamers, cutters and other hand and machine tools are ground and checked. Work of this kind is handled for the entire system.

With the discontinuance of the two-foot rule and the ordinary calipers as standard measuring instruments, we also discontinued the use of wood and lead centers in checking the lengths of main and side rods. These make-shift centers have been replaced by adjustable centers and a greater degree of accuracy is obtained by their use.

A number of gages and trams are used in fitting and assembling valve-motion parts, spring rigging and other parts. These gages are tested at regular intervals to insure the greatest degree of accuracy.

The use of special check gages and measuring devices increases the interchangeability of locomotive parts and this also leads toward standardization of many of the parts used in the construction and repair of various classes of locomotives and other equipment.

A special gage is used when mounting driving wheels to insure the crank pins being 90 deg. apart. After the wheels have been mounted with this gage the wheels are then placed in the quartering machine to test the accuracy of the workmanship.

A Rockwell hardness testing machine, shown in Fig. 7, is used for testing the hardness of all tools used in Roanoke shops. This applies to both hand and machine tools, taps, dies and all special tools manufactured in Roanoke shops for shipment to the outlying points.

Fig. 10 shows two pairs of 80-in. micrometer calipers used for checking the outside diameter of driving-wheel tires. The caliper shown in the upper part of the illustration is used for checking the diameter of tires while the wheels are in the driving-wheel tire-turning machine. The other caliper in the same view is used when checking the diameter of driving-wheel tires when the wheels are not in the lathe, or when checking unmounted driving-wheel tires. These calipers are designed to measure the outside diameter of driving wheel tires at a point $2\frac{5}{8}$ in. from the outside face of the tire to insure all tires being exactly the same diameter. The stops that are welded on the arms of these calipers fit against the inside of the face of the tire, making it impossible to take the diameter of the tire at any other location than that shown on the drawing.

Fig. 1 shows a gage designed for use in enginehouses for securing certain measurements used in filling out monthly reports showing the condition of locomotives. This particular gage is used on driving-wheel, engine-truck and trailing-truck tires. Formerly four different gages were used. The gage shown takes the place of the four gages, as the thickness of the tires, the height of the flange, the thickness of the flange and the amount of hollow wear can be measured with this one gage. The gage is very simply constructed and easily and quickly read after the measurements have been taken.

Fig. 8 shows a special tram used in Roanoke shops for tramming locomotive parts and those of machines and other equipment being built and repaired. The tram is equipped with a special device to which is attached a dial indicator, which registers the error in thousandths of an inch. This arrangement insures a greater degree of accuracy than the ordinary "fixed point" trams in common use.

A set of special gages has been designed to test the accuracy of screws and nuts during the process of manufacture. These gages are used to insure the interchange-

ability of the parts after they have been shipped to the various storehouses for use in replacing parts that have been worn to the limit prescribed for certain parts of equipment used in connection with the maintenance of locomotives.

Gage for Keyways

Fig. 6 shows a special gage used at the Roanoke shops for laying off the eccentric-crank keyways in main crank pins. These keyways are milled in the main crank pins with a portable milling machine. *A* is the body of the gage, *B* is the screw used for tightening the gage on the main crank pin and the jaws of the gage are operated by the use of a scroll which is located on the back side of the gage. *C* is the face of the gage. *D* is the end of the main crank pin in which the keyway for holding the eccentric-crank arm in position on the main crank pin is milled. *E* is the adjustable steel center used for setting the gage in the correct position to provide the proper "throw" of the eccentric crank. The face of the arm of this gage is graduated for the various classes of locomotives which insures the correct location of the eccentric crank arm after the keyways have been milled in the crank pin. The gage described above is set by a standard eccentric-crank-arm gage which is placed in the center of the driving-wheel axle with a base that rests on the end of the axle. Fig. 6 shows both gages being used. These gages make it possible to obtain the greatest degree of accuracy in locating the eccentric-crank arms in the correct position in relation to the center of the driving-wheel axle and the outer end of the main crank pin.

The gages and measuring instruments and other equipment described in this article are just a few of the many used in various departments of Roanoke shops and make it possible to obtain the greatest possible degree of accuracy in the 30,000 different orders of material that pass through the shops annually. They are also used in the manufacture of the 45,000 items that find their way into the division storehouses.

New Type of Radiation For Air Compressors

The problem of cooling compressed air between the air compressors and the main reservoirs on modern locomotives is becoming more difficult as space for the conventional pipe coils becomes more restricted. Moreover, there is considerable difference of opinion regarding the amount of radiation actually required. For example, one modern 4-8-4 type locomotive is equipped with 120 ft. of 1½-in. radiation pipe, whereas the same class of locomotive operating in the same climate and under approximately the same service conditions on another road, has only 20 ft. of 1½-in. radiation pipe because of lack of space to accommodate more.

To meet the need for more compact radiation between locomotive air compressors and the main reservoir and also to provide variable capacity for summer and winter operation, the Wilson Engineering Corporation, 122 So. Michigan avenue, Chicago, has developed a new grid-type radiation unit or section, installed as shown diagrammatically in the drawing. The cores of these sections are alloy cast iron, factory tested hydrostatically to 250 lb. per sq. in. The fins are of aluminum, cast by a secondary process on the iron core. Calculations as to equivalent effectiveness of the grid section and conventional piping have been checked by carefully conducted standing tests and indicate that one standard grid section, 34⅛ in. long, furnishes the equivalent in radiating affect of 25 ft. of 1¼-in. pipe, or 22½ ft. of 1½-in. pipe, thus making it possible to install a much greater amount of radiation surface within any given space. The weight of each grid section is 75 lb.

To meet the requirement of variability, one or more sections is arranged in parallel to be cut in or cut, as necessary to avoid freezing. The first, or series, line of radiation is direct without obstruction, and with complete drainage from the compressor to the reservoir, thus

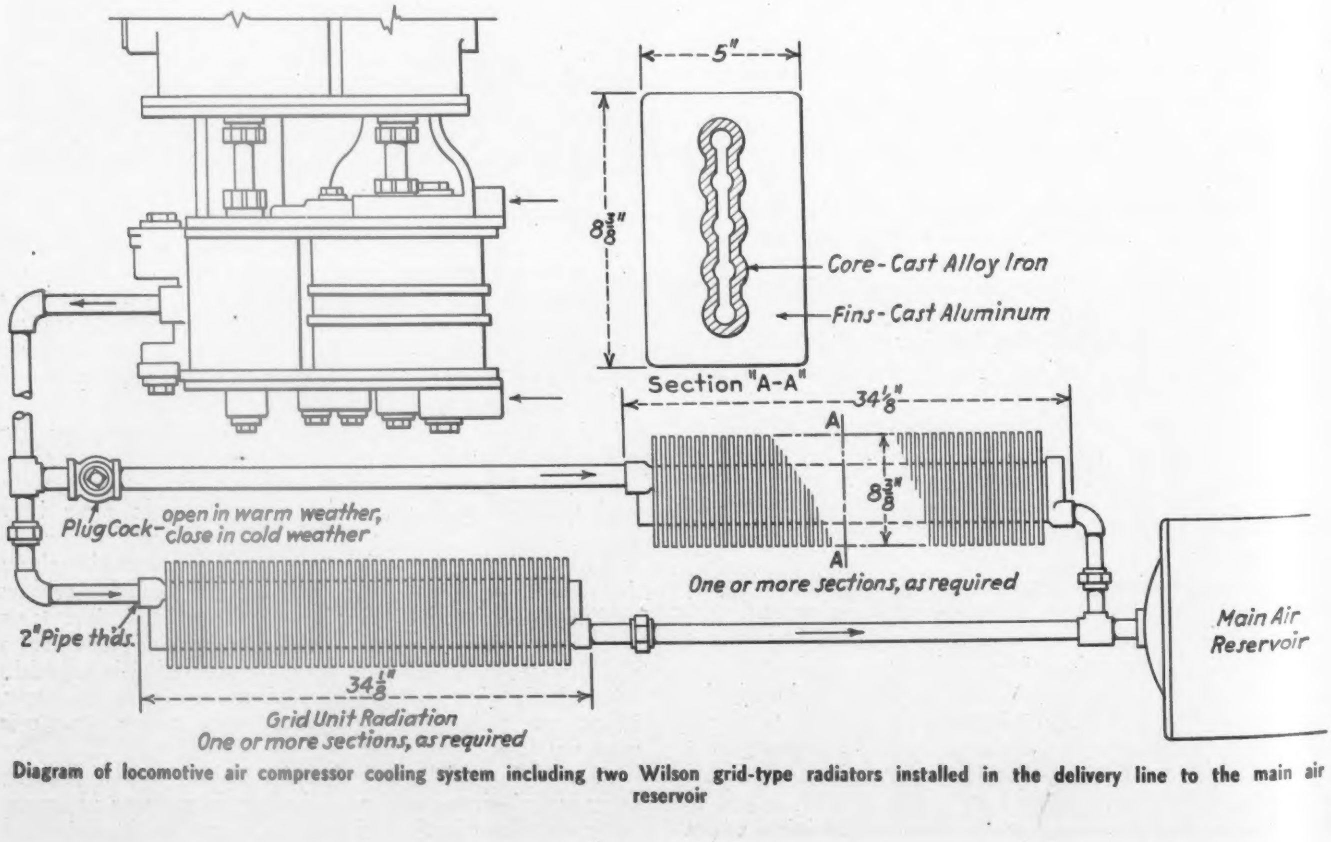


Diagram of locomotive air compressor cooling system including two Wilson grid-type radiators installed in the delivery line to the main air reservoir

assuring the absence of any hazard which might be occasioned by wrong setting of the valves, or by freezing. The parallel installation when required, is cut in by opening a shut-off cock and doubles the capacity.

The cost of the grid section compares favorably with the cost of equivalent standard piping when mounted with fittings, brackets and with consideration for labor. Substitution of grid sections for piping is recommended at times when locomotives are stripped in accordance with I. C. C. requirements, as there is then no extra labor cost. In case the piping which is removed is in good condition and can be used elsewhere, it may also be said that the application of the grid sections for compressor radiation does not entail additional investment cost.

The Wilson grid-type radiator units, designed to give compact air compressor radiation which may be easily varied in amount as desired, are said to be now in successful operation on locomotives of four railroads.

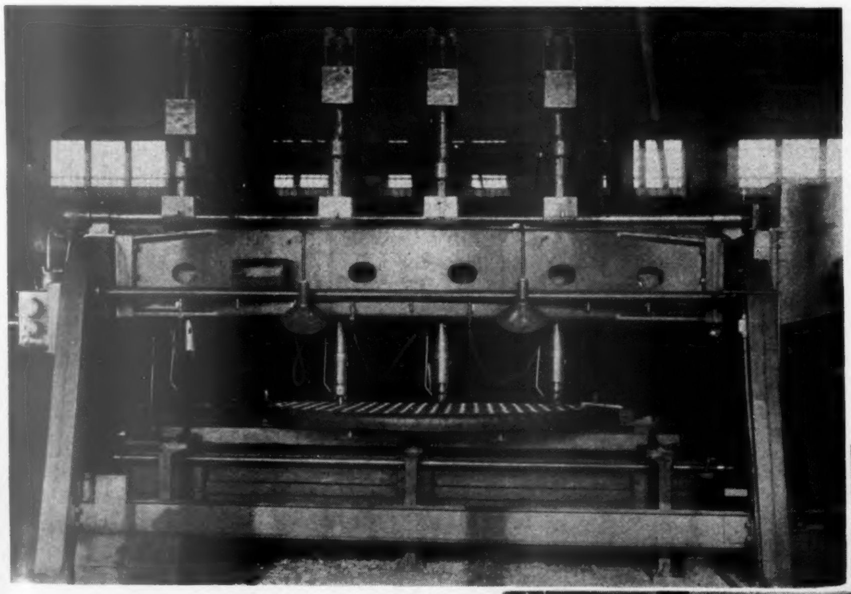
Multiple-Spindle Flue Sheet Drill

The modern four-spindle heavy-duty drilling machine, illustrated, was built by the Niles Tool Works, Hamilton, Ohio, and installed in the Union Pacific locomotive boiler shops at Omaha, Neb., a little less than a year ago. On account of its flexibility and ease of operation, the machine is adapted to a wide variety of heavy drilling operations normally encountered in boiler maintenance work, but the one job on which it has shown distinct economies is the drilling of boiler flue sheets.

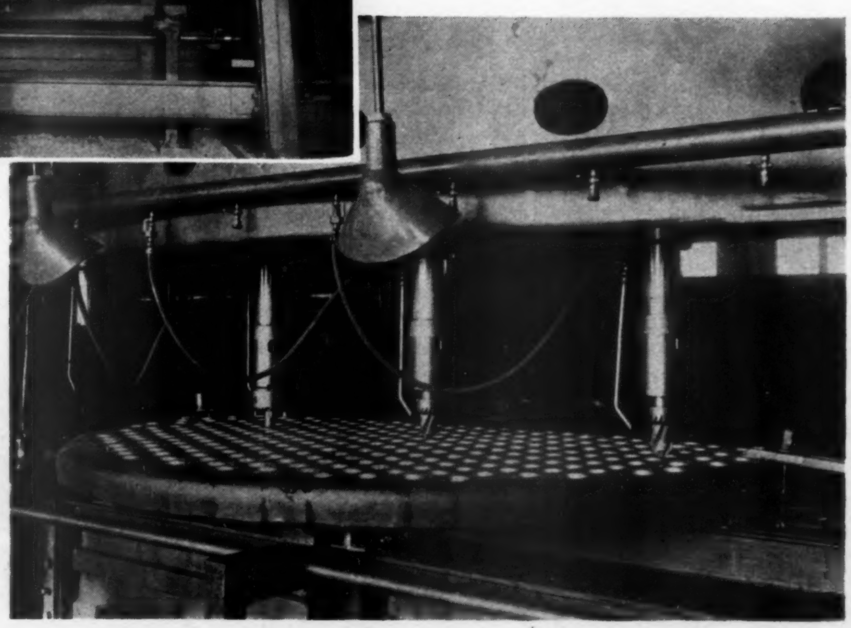
The machine is provided with push button control. Spindle speeds range from 20 to 210 r.p.m., available in 12 steps. Four feeds are available; namely, .017 in., .0125 in., .009 in., and .0065 in. per revolution.

In the drilling of flue sheet holes, which is really a production job, the holes are laid out and $1\frac{11}{16}$-in. pilot holes punched. The flue sheet is then clamped on the drilling machine table where two or three spindles may be used simultaneously as needed in cutting the holes to the proper size. In finishing the holes for $2\frac{1}{4}$-in. tubes, the combination drill and counterbore, shown in the two spindles at the right in the close-up view, is used, this tool enlarging the hole to the proper size and slightly chamfering the edge of the hole to remove the burr and leave a smooth corner which will not cut the tube bead when it is formed. A larger combination drill and counterbore is used to cut suitable holes for the swedged ends of the $3\frac{1}{2}$-in. Type-E superheater flues.

For the $5\frac{1}{2}$-in. Type-A superheater flues, the Pratt & Whitney trepanning tool, shown in the third spindle, is used. This tool is equipped with four cutters, adjustable as to position and relieved so as to cut a smooth hole $4\frac{9}{16}$ in. in diameter. The outer diameter of the tool



Left:—A modern Niles four-spindle heavy-duty drilling machine, recently installed in the Union Pacific locomotive boiler shop at Omaha, Neb.—The machine is notable for its high productive capacity and ease of operation

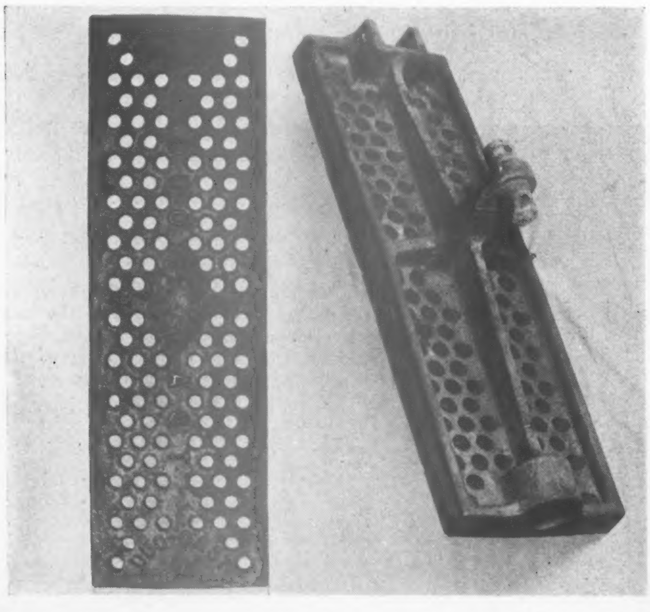


Right:—The Niles machine drilling a back flue sheet—Two spindles are shown equipped with combination drill and counterbore tools and one with a P. & W. trepanning tool, also designed to counterbore

is $5\frac{1}{2}$ in. and it is equipped with a 45-deg. counterbore, as illustrated, to remove all burrs and rough edges at each hole. Approximately 2 hr. 45 min. are required to cut forty-five $4\frac{9}{16}$-in. holes in a flue sheet with this tool. The flue sheet, shown in the illustration, has three $2\frac{5}{16}$-in. holes and 259 $3\frac{3}{16}$-in. holes which require approximately $6\frac{1}{2}$ hr. for drilling, including counterboring the holes on the reverse side with a portable air-operated tool, handled by two men.

Duo-Cast Locomotive Grates Tested

It is commonly recognized that cast iron is the best metal for heat resistance in locomotive grates, but that the strength of steel is desirable for maximum shock resistance and freedom from breakage. With this thought in mind, the Standard Brake Shoe & Foundry Company, Pine Bluff, Ark., has perfected a method of casting locomotive grates with an iron upper surface and a steel base which perform satisfactorily the double function of resisting heat in that portion of the grates subjected to the highest temperatures and giving exceptional strength in



Unretouched photographs of Duo-Cast locomotive grate removed for inspection after giving more than four times the usual grate life

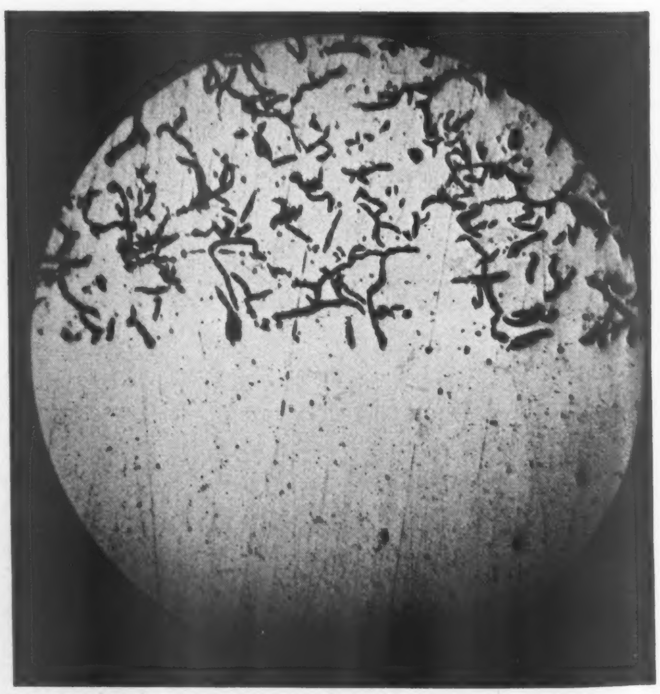
the supporting base structure. Test sets of locomotive grates, made of Duo-Cast metal, as it is called, have been in service since 1935, and, while representing a somewhat higher first cost, are said to give at least four times the service life of grates of like design made of ordinary gray iron.

One important advantage which the manufacturer claims for the use of Duo-Cast metal in locomotive grates is that no particular type or design of grate is recommended, and Duo-Cast grates can be made from present patterns, with no change in a railroad's standard grate arrangement and design. The grate mold is simply poured with molten steel in the lower part to give strength where it is needed and then, after a specified time, the iron portion is poured, filling the mold into the risers. The iron used is a special heat-resisting metal known as Stanfire iron. The iron and steel are poured in such a way as to provide a practically perfect fusion of the two metals,

Polished section of Duo-Cast grate showing effective union between the upper iron and the lower steel portions

as indicated in the illustrations, thus making a grate in which the bottom portion of the grate body and all of the underframe are made of strong cast steel, and the upper portion of Stanfire iron to protect the steel from the heat of the fire-bed.

The successful combination of these two materials in a single casting necessitated a long period of laboratory research and experimentation, using various metal combinations and different pouring methods, before the proper fusion was effected. The principal difficulty was to secure a union of the iron and steel sufficiently strong to hold in spite of differences in coefficient of expansion



Microphotograph of unetched section of Duo-Cast grate, magnified 90 diameters, indicates the practically perfect fusion of the two metals

of the two metals, and after this problem had apparently been solved in the laboratory and foundry, it was necessary to prove by service tests that the fusion of the two metals was such that they would not separate in actual service.

One factor which helped was the fact that differences of temperature in the firebox and in the ash pan are roughly in the same proportion as differences in the coefficient of expansion of iron and steel. At any rate, service tests of Duo-Cast locomotive grates, made over a period of years, seem to prove that the two metals are effectively and permanently fused and that grates made of this material are adapted to give long service life, free from sagging, warping, or growth, which would be expected with all-steel grates, and without the burning and breakage commonly experienced with grates made of ordinary gray iron.

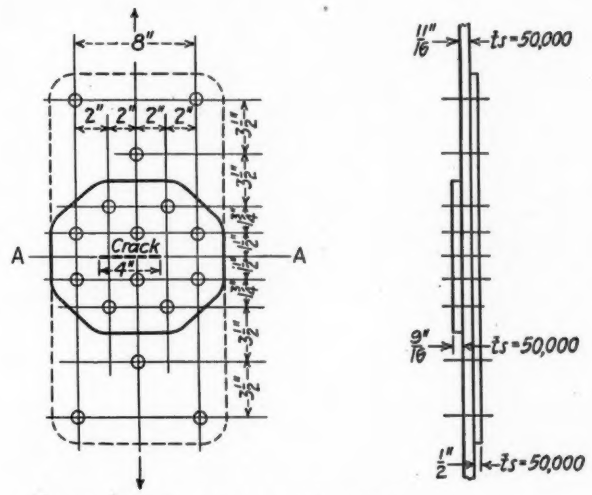
Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

the third row and shearing two rivets in single shear in the first and second rows.

(3) Shearing four rivets in double shear in the third and fourth rows and two rivets in single shear in the first and second rows; also, tearing the shell plate from



$1\frac{1}{16}$" Holes, 1" Steel Rivets, Ss=44,000 Lb. sq. in.

What is the efficiency of this patch?

the ends of the crack out to the sides of the patch.

(4) Tearing of the plate between the rivet holes in the third row and fourth rows and the welt strip in front of the two rivets in the first and second rows.

(5) Crushing of the shell plate in front of four rivets in the third and fourth rows and the welt strip in front

Efficiency of the Patch for Different Methods of Failure

$$(1)\quad \frac{(P\text{-}D) \times TS \times t}{P \times TS \times t} = \frac{(8 - 1.0625) \times 50000 \times 0.6875}{8 \times 50000 \times 0.6875} = 0.867 \text{ or } 86.7 \text{ per cent.}$$

$$(2)\quad \frac{[(P - 2D) \times TS \times t] + (2A \times s)}{P \times TS \times t} = \frac{[8 - (2 \times 1.0625) \times 50000 \times 0.6875] + (2 \times 0.8866 \times 44000)}{8 \times 50000 \times 0.6875} = 1.018 = 101.8 \text{ per cent.}$$

$$(3)\quad \frac{(4A \times S) + (2A \times s) + [(P\text{-}E) \times TS \times t]}{P \times TS \times t} = \frac{(4 \times 0.8866 \times 88000) + (2 \times 0.8866 \times 44000) + [(8\text{-}4) \times 50000 \times 0.6875]}{8 \times 50000 \times 0.6875} = 1.918 \text{ or } 191.8 \text{ per cent.}$$

$$(4)\quad \frac{[(P\text{-}2D) \times TS \times t] + (2D \times C \times B)}{P \times TS \times t} = \frac{[\{8 - (2 \times 1.0625)\} \times 50000 \times 0.6875] + (2 \times 1.0625 \times 95000 \times 0.5625)}{8 \times 50000 \times 0.6875} = 1.147 \text{ or } 114 \text{ per cent.}$$

$$(5)\quad \frac{(4D \times C \times t) + (2D \times C \times B) + [(P\text{-}E \times TS \times t]}{P \times TS \times t} = \frac{(4 \times 1.0625 \times 95000 \times 0.6875) + [(2 \times 1.0625) \times 95000 \times 0.5625] + [(8\text{-}4) \times 50000 \times 0.6875]}{8 \times 50000 \times 0.6875} = 1.922 \text{ or } 192.2 \text{ per cent}$$

$$(6)\quad \frac{(4D \times C \times t) + (2A \times s) + [(P\text{-}E) \times TS \times t]}{P \times TS \times t} = \frac{(4 \times 1.0625 \times 95000 \times 0.6875) + (2 \times 0.8866 \times 44000) + [(8\text{-}4) \times 50000 \times 0.6875]}{8 \times 50000 \times 0.6875} = 1.793 \text{ or } 179.3 \text{ per cent.}$$

The Efficiency of A Boiler Patch

Q.—Considering the ultimate strength, a piece of $\frac{11}{16}$-in. plate 8 in. wide will withstand a pull of 275,000 lb. The efficiency of a butt joint as shown in the illustration appears to be 86.6 per cent, then the joint will withstand a pull of 238,000 lb. If the straps should cover a 4 in. crack the pull on the patch would be 137,500 lb.; and the efficiency of the patch would appear to be 173 per cent. May any resistance be attributed to metal in the $\frac{11}{16}$ in. sheet along section A-A in the case of the cracked sheet?—W. H. B.

A.—The patch submitted with the question and shown in the illustration could fail in the following manner:

(1) Tearing of the plate through rivet holes in the outer row.

(2) Tearing of the plate between the rivet holes in the third row and shearing two rivets in single shear in the first and second rows.

of two rivets in the first and second rows; also, tearing the shell plate from the ends of the crack out to the sides of the patch.

The efficiency of the patch is computed by using the equations in the accompanying table; the numbers of the equations correspond to the numbers of the foregoing paragraphs. The notations used in these equations are as follows.

TS = tensile strength of plate = 50,000 lb. per sq. in.; t = thickness of shell plate = $\frac{11}{16}$ in.; B = thickness of welt strips = $\frac{9}{16}$ in.; P = pitch of rivets, on the row having the greatest pitch = 8 in.; D = diameter of rivet after driving = diameter rivet hole = $1\frac{1}{16}$ in.; A = cross-sectional area of rivet after driving, = 0.8866 sq. in.; s = shearing strength of rivet in single shear = 44,000 lb. per sq. in.; S = shearing strength of rivet in

double shear; C = crushing strength of plate = 95,000 lb. per sq. in. and E = length of crack = 4 in.

The efficiency of the patch would be the least value obtained from Equations 1, 2, 3, 4, 5 or 6 in the table which would be 86.7 per cent as found in Equation 1. The efficiency of this patch, therefore, is determined by the strength of the plate between the rivet holes of the outside pitch.

The fact that the patch covers a crack 4 in. long does not allow one to assume that the pull on the plate is only for the length of the cracked portion. The pull on the plate between the outer row of rivets will be 275,000 lb. irrespective of the length of the crack; therefore, the efficiency through the outside row of rivets or 86.7 per cent, will be the efficiency of the patch whether the length of the crack is 4 in. or 8 in. In determining the efficiency of the patch, Equations 3, 5 and 6 in the table are affected by the length of the crack.

Open and Sealed Arches Are Defined

Q.—What is meant by a sealed and an open arch? Which is considered the best type of arch construction?—A. P.

A.—A sealed arch is one where the firebrick is set down next to the firebox throat sheet, the brick being tight against the sheet or sealed with fire-clay.

An open arch is one where the firebrick adjacent to the firebox throat sheet is set back away from the sheet by means of spacer bricks, leaving an opening between the sheet and the first row of firebricks.

The use of the sealed or open arch depends upon the construction of the arch, the use of syphons, and the kind of coal burned. It can only be determined by trial which type of arch construction is the best for a given boiler, and for different kinds of coal used in the same boiler.

With a sealed arch there is a tendency for cinders and slag to form in the pocket formed by the arch and the tube sheet; the cinders and slag plug up the lower tubes. To overcome this condition, the open arch is installed, allowing the cinders to fall down onto the grates.

In applying spacer bricks, care should be taken to keep the top of the arch down, so as not to restrict the gas area between the back end of the arch and the crown sheet, or the gas area between the back end of the arch and the firedoor sheet, to less than 115 per cent of the total flue and tube area.

Maximum Allowable Working Pressure on Water Tubes

Q.—If in a water-tube boiler the tubes enter a 42-in. drum at a butt seam, the thickness of the plate is 5/8 in., the thickness of the straps is 9/16 in., and the ligament efficiency is 36.6 per cent, what is the maximum allowable working pressure?

A.—The maximum allowable working pressure on the shell of a boiler or drum for temperatures not to exceed 700 deg. F. shall be determined by (1) the strength of the weakest course, computed from the thickness of the plate with the tensile strength stamped thereon as provided for in the specifications for the material, (2) the efficiency of the longitudinal joint or of the ligament between the tube holes in the shell or drum (whichever is the least), (3) the inside diameter of the course, and (4) the factor of safety.

The maximum allowable working pressure can be determined from the formula

$$P_m = (TS \times t \times E) / (FS \times R)$$

where P_m = maximum allowable working pressure, lb. per sq. in.; TS = ultimate strength of the plate, lb. per sq. in.; t = minimum thickness of the shell plates in the weakest course, in.; E (the efficiency of the longitudinal joint or of ligaments between openings) for riveted joints = calculated riveted efficiency; E for fusion-welded joints = efficiency specified in Paragraph P-102 of the A. S. M. E. Boiler Code for seamless shells = 100 per cent; E for ligaments between openings = efficiency calculated by rules in Paragraphs P-192 and P-193 of the A. S. M. E. Boiler Code; FS = factor of safety = 5 for new construction; and R = inside radius of the weakest course of the shell or drum, in., provided the thickness of the shell does not exceed 10 per cent of the radius, or = the outer radius of this course when the thickness is over 10 per cent of the radius. The factor of safety used in determining the maximum allowable working pressure, calculated on conditions actually obtained in service, shall not be less than 5.

Substituting the values given in the question, and assuming TS = 55,000 lb. per sq. in. and FS = 5, we obtain the maximum allowable working pressure as $(55{,}000 \times 0.625 \times 0.366) / (5 \times 21) = 12{,}381.25.105$ = 119.8 lb. per sq. in.

The Cracking of Outside Throat Sheets

Q.—We have considerable trouble with outside throat sheets cracking. The cracks extend vertically in the radius joining the throat sheet and the shell course. Can this trouble be overcome? Also, what is the proper way to repair a crack of this type?—R. E. L.

A.—The cracking of the throat sheet as stated in the question is no doubt due to stresses set up in the metal at this point due to the expansion and contraction of the boiler.

When the boiler is heated from a cold condition to full boiler pressure, there is a movement in the throat sheet, the plate tending to straighten out horizontally, and when the boiler becomes cold again, the sheet returns to its original position. The action of the water in the boiler also causes the temperature of the plates to vary, which results in a movement of the throat sheet. The more rapid the temperature changes, the quicker the fracture develops in the sheet.

The cracks also occur due to internal stresses set up in the plates at the time of flanging; there is considerable thinning of the plate at the time of flanging because of the extreme amount of flanging required in the throat sheet.

The design of the throat sheet itself might be the cause, in that, the radii of the corners are not sufficient to allow the necessary freedom in the plate for expansion and contraction.

A rigid connection between the throat sheet and the engine frame would also set up stresses in the throat sheet, due to the fact that the engine frame is rigid and the boiler expands and contracts.

This trouble can be corrected to some degree by installing sliding shoes where the boiler rests on the frame at the throat sheet; also, by lagging and jacketing the throat sheet, and by providing ample radii at the throat-sheet corners when making new throat-sheet applications.

To repair a throat-sheet crack, the crack should be veed out and welded, and a riveted patch, the same thickness as the throat sheet, applied over it. The patch should extend from the shell-course seam out to the firebox wrapper-sheet seam.

A comprehensive discussion of this subject appears in the 1938 proceedings of the Master Boiler Makers' Association.

High Spots in
Railway Affairs . . .

Wanted—A Name

Where does the Pullman Company get the names for its cars? Wherever it is, the source of supply seems to be running low and so that company is now offering prizes for the best name to be given the new Pullman "roomette" sleeping car which is being exhibited at the New York World's Fair. Entry blanks are to be distributed by ticket and Pullman agents. The prizes will include two free round-trips by Pullman to either the San Francisco or New York fair to those originating the 25 best names submitted, and 500 new one dollar bills for the "runners up."

Senate Transportation Hearings

When the Senate finally got around to considering transportation legislation it went at it with a will. Hearings on the Wheeler-Truman S. 2009, known as the "key bill" for Senate transportation legislation, began on April 3 and closed on April 14. Senator Wheeler insisted that no time be wasted and that the testimony be brief and to the point. With the hearing on that bill out of the way, hearings have been scheduled for the other Wheeler-Truman bills, including S. 1869 to amend the provisions of the law relating to railroad reorganizations; S. 1310, which will give the Interstate Commerce Commission regulatory authority over the so-called outside investments of the railroads; and S. 2016, the holding company bill. It is proposed to make these hearings broad enough to cover other bills which deal in one way or another with matters covered in the Committee-of-Six recommendations. These hearings will be cleared up expeditiously if Senator Wheeler maintains the pace that he has started.

Defends High Passenger Fares

The eastern railroads in July, 1938, were given permission by the Interstate Commerce Commission to increase their basic passenger fares 25 per cent, from 2 to 2½ cents per mile. A report recently issued shows that in the first six months of operation under the increased fare, there was a smaller decrease in revenues on the eastern railroads than in the southern and western groups, which operated under lower fares, chiefly 1.5 cents and 2 cents. The decline in passenger revenues for the six months ended February 1, 1939, for the eastern region averaged 8 per cent, as against the same six months in 1937 and 1938; for the western group the decline was 9.4 per cent, and for the southern group 15.6 per cent. The report says that while the experience gained since July has not been of long enough duration to be conclusive, the results thus far may well be regarded as significant.

Amlie Withdraws

Thomas R. Amlie, who was nominated by President Roosevelt to succeed Interstate Commerce Commissioner Balthasar H. Meyer, finally, after a long delay, requested the President to withdraw his name because of the intense opposition which developed in the Senate, making it impossible to secure confirmation of the nomination. Judging from his letter withdrawing the nomination, the President keenly resented the Senate's attitude. Mr. Amlie, who certainly owed the President some consideration for the courtesies extended to him by the Chief Executive, took a queer way of showing his appreciation. In a public statement which bristled with all sorts of sharp criticisms of his opponents, he passed the buck back to the President in these words: "The real explanation of the savage attack on me lies not in my own deeds or misdeeds, but in the political calculation that by branding me as a Communist and an anti-Christ, a real blow—a blow below the belt to be sure, but nonetheless a real blow—could be struck against you, Mr. President, and your administration."

One Railroad Bill Gets Under Way

The Chandler rail bill, HR-5407, which would give legal sanction to voluntary railroad reorganizations, has been passed by the House and sent to the Senate. The Senate has no companion bill and there is a question just how promptly the House bill will be given consideration. In the words of its author, "it is an effort to reduce to its simplest form a method for the reorganization of those railroads which have submitted their financial problems to their bondholders, stockholders and creditors, generally, and have obtained the approval of more than two-thirds of the aggregate amount of all claims affected by the proposed plan of reorganization." It is understood that Assistant Secretary of State A. A. Berle, Jr., is opposed to the bill. He has sent a letter to Senator Wheeler contending that it would permit the piling up of stale claims against a railroad, which would have to be paid or written off later, instead of resulting in a writing down of existing debts and interest charges.

Ten Minutes For Ten Cents

The transportation agencies in the New York metropolitan district are preparing for heavy traffic during the World's Fair. The Long Island Railroad expects exceptionally heavy traffic between the Pennsylvania Station in New York City and its special World's Fair Station, which was recently completed and will have a capacity for handling 20,000 people an hour in each direction. Trains made up of 12 multiple-unit electric cars will operate a non-stop shuttle service. These trains, each of which will accommodate about 900 persons, are scheduled for every few minutes in both directions during the hours the fair is open. Because of the nature of the traffic, no tickets will be issued, but automatic turnstiles will be provided at the station concourse for the flat 10-cent fare both for inbound and outbound passengers.

Transportation Legislation in the House

Hearings on the transportation bills in the House, extending over ten weeks, were completed on March 30. Immediately thereafter the Committee on Interstate and Foreign Commerce, in executive session, authorized the appointment of a sub-committee to take over the task and make recommendations. This sub-committee consists of the chairman of the committee, Clarence F. Lea of California, Representatives Crosser of Ohio, Bulwinkle of North Carolina, and Cole of Maryland, Democrats; also Wolverton of New Jersey, Holmes of Massachusetts, and Halleck of Indiana, Republicans. Naturally their recommendations will be awaited with keen interest. Chairman Lea is entitled to a lot of credit for the statesmanlike and thorough way in which his committee has functioned. It remains to be seen, whether out of all the great mass of conflicting material in their hands they can sort out the essentials and draft a bill or series of bills that will receive the approval of Congress and bring us nearer the solution of the transportation problem.

Among the Clubs and Associations

NEW ENGLAND RAILROAD CLUB.—Annual banquet and entertainment May 9, Copley-Plaza Hotel, Boston, Mass.

TORONTO RAILWAY CLUB.—Meeting: April 24, Royal York Hotel, Toronto. A. A. R. sound slide films—"This Railroad Business," and "Friendliness Too."

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Dinner 6:15 p. m., May 16, Hotel DeSoto, St. Louis, Mo.; meeting 8 p. m. Subject: Electric Welding as Applied to Railroad Equipment, with motion pictures. Speaker: E. W. P. Smith, consulting engineer, Lincoln Electric Company.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS, AND SOUTH OMAHA INTERCHANGE.—Meeting: 1:30 p. m., May 11, Union Pacific, Council Bluffs, Iowa. Subject: Rules 68 to 75. Speaker: C. B. Stemple.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—Meeting: May 1, Hotel Severin, Indianapolis, Ind. Subject: Locomotive Slipping Tests, with motion pictures and slides. Speaker: T. V. Buckwater, vice-president, Timken Roller Bearing Company.

EASTERN CAR FOREMEN'S ASSOCIATION.—Meeting: April 14. Subject: Talking motion picture "The Story of the Chilled Car Wheel," with contributory paper on Wheel Defects and Failures by P. J. Hogan, supervisor car inspection and maintenance, New York, New Haven & Hartford.

CO-ORDINATED MECHANICAL MEETINGS.—Owing to a conflict in date with the American Legion convention, which will tax hotel accommodations to the limit in Chicago during the last week in September, arrangements have been made to hold the co-ordinated mechanical association meetings, without exhibits, at the Hotel Sherman during the third week in October. These associations include the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the International Railway General Foremen's Association and the Master Boiler Makers' Association.

Present plans call for a joint opening session to be addressed by an outstanding railway officer on Tuesday morning, October 17. The various associations will then adjourn to their respective meeting rooms for the consideration of individual papers and committee reports on the subjects in which each is especially interested. It is expected that an exhibition of railway equipment and supplies, sponsored by the Allied Railway Supply Association, will be held at the 1940 meeting of these associations.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting June 28, 29 and 30, at the Commodore Hotel, New York.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York. Convention of entire membership June 14-15, Palmer House, Chicago.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Meeting third week in October, Hotel Sherman, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMAN'S ASSOCIATION.—Roy MacLeod, Room 127, G. O. Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association. Meeting third week in October, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—F. T. James, general foreman D. L. & W., Kingsland, N. J.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Meeting third week in October, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

RAILWAY CLUB OF GREENVILLE.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—P. A. Bissell, 40 Broad street, Boston, Mass.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago. Meeting third week in October, Hotel Sherman, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

(*Turn to next left-hand page*)

The unique exchange plan, possible only because a scrap wheel is the best basic raw material for a new wheel, has made, and will continue to make chilled car wheels more economical to buy, just as their unusual characteristics make them more economical to operate.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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445 N. SACRAMENTO BLVD.,
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ORGANIZED TO ACHIEVE:
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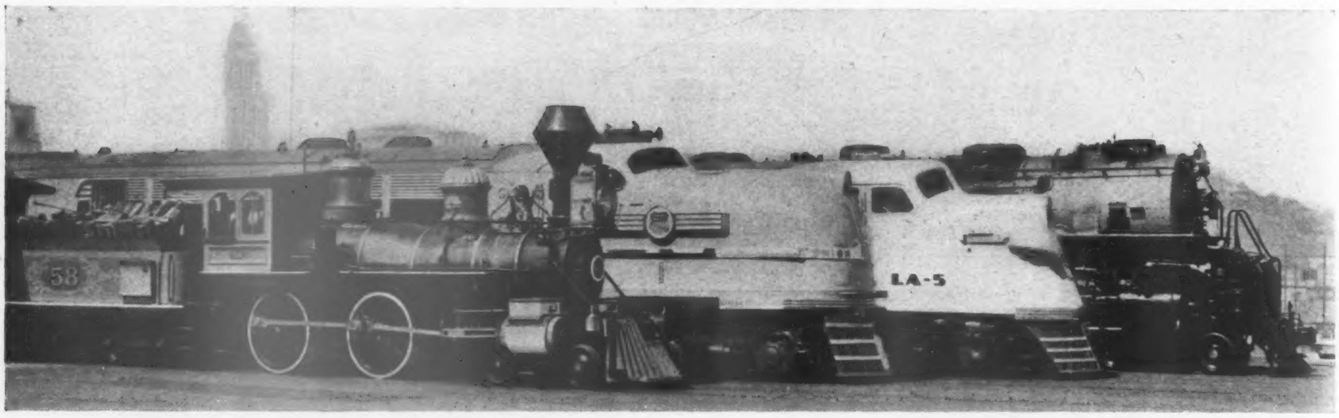


Old and new Union Pacific locomotives lined up at Los Angeles, Calif., preceding the world premier of the film "Union Pacific." Left to right: A wood-burning steam locomotive used in 1865; the new 5,000-hp. steam-electric locomotive built by the General Electric Company; the "City of Los Angeles" locomotive, built by the Electro-Motive Corporation, and a high-speed articulated steam freight locomotive built by the American Locomotive Company. The wood-burning and steam-electric locomotives are now on a transcontinental exhibition tour

NEWS

$45,000 for A. A. R. Research on High-Speed Freight Car Trucks

THE board of directors of the Association of American Railroads, at its March 31 meeting in Washington, D. C., voted a $45,000 appropriation for a one-year research project on high-speed freight car trucks.

J. J. Pelley, president of the Association of American Railroads, in a statement issued since that meeting, reveals that the project will take the form of "a series of tests to determine what improvements can be made in the construction of railroad freight-car trucks in order to better fit them to meet operating conditions resulting from greater high-speed freight service.

"These tests," Mr. Pelley continues, "will be the most comprehensive of their kind ever conducted by the railroads. Out of them are expected to result the development of a freight-car truck that can be used on freight trains moving at speeds as great as the fastest passenger trains now being operated in the United States. . . . Due to improvements in locomotives and freight cars and methods of operation, the average speed of freight trains in 1938 was 61 per cent higher than in 1920. In many instances freight trains are now being operated on what were formerly passenger-train schedules.

"The purposes of these tests will be to bring about: (1) Still greater improvement in safety on the railroads; (2) a continued improvement in service to the public by expediting still further the movement of freight; (3) reduced maintenance, both to equipment and road-bed; and (4) increased efficiency in operation."

Approximately one year is expected to be required to complete the tests and the preparation of a report. The road tests will be run over the Pennsylvania from Altoona, Pa., to Lock Haven, Pa., a round trip distance of 156 miles. They will be under the general direction of W. I. Cantley, mechanical engineer, Mechanical Division of the A. A. R. W. E. Gray, engineer of draft-gear tests of the Association, will be in direct charge of the tests.

Railroad freight-car truck manufacturers located in various parts of the United States have turned over to the A. A. R. about a dozen different types of freight-car trucks for testing purposes. Each one will be given a separate and thorough test under varying conditions, both as to load of cars and as to speed. Test runs between Altoona and Lock Haven will be made every other day, the intervening time between runs being devoted to installing the various freight-car trucks and to making changes in the load of the cars used in the test runs.

Machinery and Tools

THE Missouri Pacific will spend approximately $110,000 for machinery and tools with which to improve efficiency and reduce operating costs in its car and locomotive shops. Orders have been placed as follows: with the Hoffmann-Marquard Iron & Machinery Company, St. Louis, Mo., for a planer and matcher to be built by the Yates-American Machinery Company, Beloit, Wis., for use at its machine shop at DeSoto, Mo., and with the R. R. Stephens Machinery Company, St. Louis, for two 24-in. vertical boring mills, to be built by the Bullard Machine Tool Company, Bridgeport, Conn., for installation in the railroad's Ewing avenue shops at St. Louis, and the enginehouse machine shop at North Little Rock, Ark. A 30-in. engine lathe has been ordered from the Lehmann Machine Company, St. Louis, for installation in the railroad's machine and erecting shop at Kansas City. A punch and shear has been ordered from Williams, White & Company, Moline, Ill., for use in the railroad's shops at DeSoto. An order has been placed with the Blackman & Neutzel Machine Company, St. Louis for a machine to process locomotive bolts, which is being built by the Sunstrand Machine Company, Rockford, Ill., for installation in the shops at Sedalia.

Revised Specifications for Passenger Equipment

REVISED specifications for passenger equipment recommended by the General Committee of the Association of American Railroads, Mechanical Division, were approved by the A. A. R. board of directors at its Washington, D. C., meeting on March 31. The board also directed that the specifications thus approved be transmitted to member roads for adoption as recommended practice of the A. A. R.

The revised specifications were sent out to member roads on April 4 with a letter from A. A. R. President J. J. Pelley. The material accompanying Mr. Pelley's letter reveals that the revised specifications were prepared on a basis whereby they will produce passenger cars suitable for use with cars of all types of construction, now in service and built in accordance with Railway Mail Service Specifications, as revised July 30, 1938—with the result that new and existing cars will satisfactorily operate together with maximum protection under all conditions of service.

Reviewing developments leading to the adoption of the revised specifications, the Pelley letter to member roads recalls that on January 9, 1939, a Special Engineering Committee of the Mechanical Division was appointed to prepare, in co-operation with car builders and materials manufacturers, a set of minimum specifications to cover future construction of new passenger cars. Specifications were prepared and submitted to the A. A. R. board on February 24, whereupon the board directed the Mechanical Division to submit such specifications to member roads for comment and suggestions. On the basis of such comment

(Continued on next left-hand page)

and suggestions, the Mechanical Division's Special Engineering Committee prepared a revised set of specifications which was approved by the General Committee and recommended for adoption as recommended practice.

Proceedings Fuel and Traveling Engineers' Association

The proceedings of the Railway Fuel and Traveling Engineers' Association cost $3, not $2 as mentioned in the review on page 107 of the March issue of the *Railway Mechanical Engineer.*

Air Conditioning—Correction

In the table showing the Nine-Year Summary of Air-Conditioned Cars appearing on page 141 of the April issue, the total of 275 cars of the C. M. St. P. & P. appearing as ice-equipped should be shown as equipped with the steam-ejector system. This transfer changes the grand totals of ice-equipped cars from 4,055 to 3,780 and of the steam-ejector-equipped cars from 1,587 to 1,862.

Stoker Appeal Deferred

Railroads will defer their decision with respect to further court appeals from the Interstate Commerce Commission's order in the automatic stoker case until J. J. Pelley, president of the Association of American Railroads, has had an opportunity to discuss the matter with D. B. Robertson, president of the Brotherhood of Locomotive Firemen & Enginemen. This decision was reached at a meeting of the A. A. R. board of directors held at Washingon, D. C., on March 31.

As noted in the April issue of the *Railway Mechanical Engineer,* the Interstate Commerce Commission had postponed to April 15 the effective date of this order, which had recently been upheld by a three-judge federal court at Cleveland, Ohio.

Experimental Cars Authorized

The Interstate Commerce Commission, in a decision by Commissioner McManamy, has authorized the General American Transportation Corporation to construct 30 additional fusion-welded tank cars for experimental service in the transportation of caustic soda solution.

The Commission, through Commissioner McManamy, has also authorized the Union Tank Car Company to construct 100 fusion-welded tank cars for experimental service in the transportation of petroleum products.

$583,282,000 for Supplies in 1938

Purchases of fuel, materials and supplies used by the Class I railroads in the United States in connection with their operation amounted to $583,282,000 in 1938, J. J. Pelley, president of the Association of American Railroads recently announced. These 1938 purchases were smaller than in any year since 1933 and were a reduction of $383,101,000 under those in 1937. The reduction under the preceding year, Mr. Pelley's statement says, "resulted primarily from the serious financial condition of the railroads, and from enforced reductions in maintenance work, as well as increased efficiency in operation which particularly affected fuel purchases."

In 1930 railway purchases for fuel, materials and supplies amounted to $1,038,500,000.

Class I railroads in 1938 expended $243,783,000 for fuel compared with $294,293,000 in 1937. For bituminous coal only, their purchases totaled $180,074,000, a decrease of $36,201,000 compared with the preceding year, while for anthracite, they totaled $3,333,000, a decrease of $575,000 compared with 1937. Purchases of fuel oil in 1938 amounted to $53,553,000 compared with $65,856,000 in the preceding year. For gasoline, there was an expenditure of $4,120,000 in the past year, while for all other fuels, including coke, wood, and fuel for illumination, expenditures amounted to $2,703,000.

Class I roads, in 1938, purchased iron and steel products amounting to $152,176,000 compared with $359,409,000 in 1937, or a decrease of $207,233,000. For locomotive and car castings, beams, couplers, frames and car roofs, the railroads spent $22,221,000 in 1938 compared with $62,373,000 in the preceding year.

For wheels, axles and tires, the railroads expended $16,691,000 compared with $31,173,000 in the preceding year, while for bar iron and steel, spring steel, tool steel, unfabricated rolled shapes, wire netting and chain, boiler, firebox, tank and sheet iron and steel of all kinds their expenditures amounted to $7,910,000 compared with $32,186,000 in the preceding year. Purchases of standard and special mechanical appliances for locomotives in 1938 totaled $6,447,000.

Miscellaneous purchases made by the Class I roads totaled $130,355,000 in 1938 compared with $207,974,000 in 1937. Under the heading were $14,237,000 for lubricating oils and grease, illuminating oils, boiler compound and waste; $3,696,000 for passenger car trimmings, and $5,792,000 for locomotive, train and station supplies.

Lackawanna's World's Fair Exhibit

The equipment exhibit of the Delaware, Lackawanna & Western which recently arrived at the site of the New York World's Fair after exhibition at various points along the road's main line from Scranton, Pa., to Hoboken, N. J., consists of old locomotive No. 952, a "Mother Hubbard" type of the 4-4-0 wheel classification in service on the road between 1900 and 1937; a modern passenger locomotive bearing the number 1939; a present-day refrigerator car, and a special lading car for handling bulk cement. Locomotive No. 952 will be presented to the Railway & Locomotive Historical Society at the close of the Fair. Locomotive 1939 has been fitted with a side panel skirting the boiler, upon which is inscribed "Pocono Mountain Route," while the name of the railroad has been applied in gold leaf on the tender, together with striping in silver leaf.

Equipment Depreciation Rates

Equipment depreciation rates for seven railroads including the Boston & Maine have been prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies. The composite percentages which are not prescribed rates range from 2.91 for the B. & M. to 10.96 for the Southern New Jersey.

The sub-order relating to the B. & M. is a modification of a previous sub-order, and it prescribes rates as follows: Steam locomotives, 3.01 per cent; other locomotives, 3.1 per cent; freight-train cars, 2.91 per cent; passenger-train cars, 2.63 per cent; work equipment, 3.67 per cent; miscellaneous equipment, 14.07 per cent.

New Equipment Orders and Inquiries Announced Since the Closing of the April Issue

Locomotive Orders

Company	No. of Locos.	Type of Loco.	Builder
Missouri Pacific	2	900-hp. Diesel-elec.	Electro-Motive Corp.
	2	600-hp. Diesel-elec.	
	1	1,000-hp. Diesel-elec.	
	1	1,000-hp. Diesel-elec.	Baldwin Loco. Works
	1	1,000-hp. Diesel-elec.	American Loco. Co.
Phelps Dodge Corp.	4	1,000-hp. Diesel-elec.	Electro-Motive Corp.
Wabash Car & Equip. Co.	3[1]	600-hp. Diesel-elec.	Electro-Motive Corp.
	1[1]	600-hp. Diesel-elec.	American Loco. Co.

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Great Northern	1,000[2]	50-ton box	Pullman-Std. Car Mfg. Co.
Maine Central	300	40-ton box	Magor Car Corp.
Missouri Pacific	1,025[3]	Gondola	Mt. Vernon Car Mfg. Co.
	125[3]	Box	
United Carbon Co.	10	40-ton hopper	American Car & Fdry. Co.

Freight-Car Inquiries

Union Railroad Co.	10	Caboose	....
Union Tank Car Co.	10-30	4,600-gal. tank	....

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Missouri Pacific		See Footnote[3]	
Pullman Co.	2[4]	Sleepers	Pullman-Std. Car Mfg. Co.

[1] To be leased to the receivers of the Wabash Railway Co.

[2] Approximate cost $3,000,000.

[3] The box cars and 25 gondolas are for the Missouri Illinois. The order for the locomotives for the streamline trains has been placed with the Electro-Motive Corporation and the order for the cars with the American Car and Foundry Company. Each of the trains will consist of a 2,000-hp. locomotive, a mail-baggage car, a mail-storage-express car, two deluxe coaches, a diner-cocktail-lounge car and a parlor-observation car. They will be placed in service between St. Louis, Mo., and Omaha, Neb., on a schedule of 9-hr. The cost of the trains, the locomotives, and the freight cars is estimated at $5,000,000.

[4] For use in the City of Denver of the Union-Pacific-Chicago & North Western. Each car will contain four roomettes, four double bedrooms, three compartments and one drawing room.

(Turn to second left-hand page)

SECURITY CIRCULATOR

AFTER 5 YEARS OF TESTING ON 12 RAILROADS

A number of years ago the increasing size of fireboxes started the American Arch Company engineers looking for a more satisfactory method of supporting arches of unusual length.

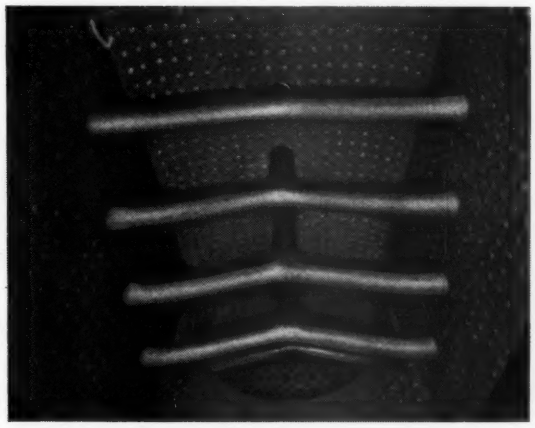
From this the Security Circulator has developed.

Now after 5 years of successful testing of over 100 Circulators in 22 locomotives, on 12 railroads, the American Arch Company announces Security Circulators for application to any type of steam locomotive.

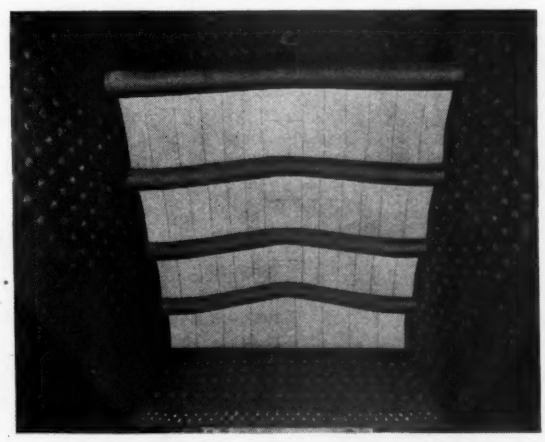
Test applications on every type of modern power under the worst water conditions have shown the Security Circulator to have the following advantages:

1. It supplies a better arch support; permitting the use of a 100% arch in any type of firebox.
2. It reduces honeycombing, flue plugging and cinder cutting.
3. It creates circulation in the side water legs.
4. It improves combustion.

Security Circulators have been so successful on test that we are now receiving many repeat orders.



View illustrating the positioning of Security Circulators in an average size of locomotive firebox prior to installing the brick arch.



Typical Security Circulator and brick Arch Installation in a locomotive firebox. The small sectional brick are as readily applied as in an ordinary arch tube firebox.

ARCH COMPANY, INC.

Security Circulator Division

Supply Trade Notes

Harry Glaenzer, vice-president of The Baldwin Locomotive Works, has assumed new and enlarged responsibilities in connection with the engineering activities of the company. He will devote all his time to research and investigation in an effort to develop advances and improvements in the field of railway motive powers. Ralph P. Johnson has been appointed chief engineer, succeeding Mr. Glaenzer, and Charles F. Krauss and E. J. Harley, Jr., will as-

Harry Glaenzer

sist Mr. Johnson, each with the title of assistant chief engineer.

Mr. Glaenzer received his education in the technical schools of Baltimore, Md., and the University of Pennsylvania. He first became connected with the engineering department of The Baldwin Locomotive Works in March, 1899, and was appointed vice-president in charge of engineering on July 1, 1922.

◆

H. B. Spackman, vice-president in charge of sales of Lyon Metal Products, Inc., Aurora, Ill., has been elected a di-

H. B. Spackman

rector. Mr. Spackman has been with the Lyon company for two years, coming to them from the U. S. Gypsum Company.

◆

Paul A. Condit has joined the Cooper-Bessemer Corporation, Mt. Vernon, Ohio, in the capacity of control engineer.

Charles L. Heater, assistant vice-president of the American Steel Foundries, Chicago, has been elected vice-president. Mr. Heater was born in Mandan, N. D., on August 5, 1894, and was graduated from Purdue University in 1917. Upon graduation, he entered the army air service and

Charles L. Heater

served overseas for eighteen months as captain of the 11th Aero Squadron. On November 1, 1919, at the end of the war, he entered the employ of the American Steel Foundries as a traveling apprentice, and after working in various plants throughout the country, was appointed sales agent at Chicago on January 1, 1925. He held this position until April 1, 1932, when he was promoted to general sales engineer. On November 1, 1937, he became assistant vice-president.

◆

Henry Jude has been appointed general sales manager of the Locomotive Equipment Division of Manning, Maxwell &

Henry Jude

Moore, Inc., Bridgeport, Conn., to succeed C. H. Butterfield, who was recently elected vice-president in charge of sales of the Industrial and Locomotive Divisions. Mr. Jude has been associated with the corporation for the past 33 years, having started in 1905 as an office boy. His various promotions have covered sales work in numerous capacities, also office management, and in 1934 he was appointed assistant general sales manager of the Locomotive Equipment Division. He is a Mechanical Engineer with a B.S. degree. During the emergency of the National Industrial Recovery Act in 1933 he was elected a member of the Code Authority in which capacity he represented Manning, Maxwell & Moore, Inc., in the Locomotive Appliance Institute.

◆

Ervin J. Sanne, district sales manager of the Inland Steel Company, with headquarters at St. Paul, Minn., has been ap-

Ervin J. Sanne

pointed assistant manager of sales of the Sheet and Strip Steel division, with headquarters at Chicago, and has been succeeded by Frederick A. Ernst, assistant district sales manager at St. Louis, Mo. Harry A. Johnson of the St. Paul office has been appointed assistant district sales manager at St. Paul.

E. J. Sanne has been district sales manager of the Inland Steel Company at St. Paul since 1936. Prior to that time he

Frederick A. Ernst

was associated with Joseph T. Ryerson & Son, Inc., now a subsidiary of the Inland Steel Company, having entered the employ of that company in 1917. He was in the sales department at Chicago from 1921 to 1936.

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THE SUPERHEATER AS A FACTOR IN LOCOMOTIVE DESIGN

Reduced Fuel and Water Consumption Per Unit of Work Done

Locomotives equipped with Type "E" superheaters have shown this advantage to a high degree, as compared with other types and designs.

On a test plant in the United States, a locomotive underwent two comparative tests, first equipped with a Type "A" superheater and second with a Type "E" superheater. Except for the difference in superheaters, the locomotive was identical in each instance. The economies resulting from this test, which are disclosed in the accompanying table, are typical of the results that are being obtained in daily service.

COAL CONSUMPTION PER IHP

Output IHP	Type "A" Superheater	Type "E" Superheater	Reduction in Pounds	Saving in Per Cent
2000	2.85	2.25	0.6	21.0
3000	3.50	2.75	0.75	21.5
3500	4.25	3.25	1.0	23.5

THE SUPERHEATER COMPANY

ELESCO

A-1318

Representative of AMERICAN THROTTLE COMPANY, INC.

60 East 42nd Street, NEW YORK 122 S. Michigan Ave., CHICAGO

Canada: THE SUPERHEATER COMPANY, LTD., MONTREAL

Superheaters • Exhaust Steam Injectors • Feed Water Heaters • American Throttles • Pyrometers • Steam Dryers

F. A. Ernst has been assistant district sales manager of the Inland Steel Company at St. Louis, Mo., since 1936. He entered the steel industry in 1914 with the Trumbull Steel Company and was successively affiliated with the Falcon Steel Company, the Granite City Steel Company and the Columbia Steel Company, prior to his association with the Inland Steel Company at St. Louis in 1928.

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THOMAS O'LEARY, JR., sales manager of the Western division of the Transportation Department of the Johns-Manville Sales Corporation, has been advanced to the position of sales manager of the Western Region of the Transportation Department, having jurisdiction over the Western, Southwestern and Pacific divisions of that department. His headquarters will be in Chicago, as heretofore. C. M. Patten has been appointed sales manager of the Southwestern division of the Transportation Department at St. Louis, Mo., succeeding A. C. Pickett, who has resigned.

Thomas O'Leary, Jr.

C. M. Patten

Mr. O'Leary was born at San Francisco, Calif., and received his early training on the Southern Pacific. In 1911 he became associated with the New York Air Brake Company as mechanical representative in San Francisco, and later was sales representative at Denver, Colo. He then served, successively, as a second lieutenant and as a captain in the army, on his return after 15 months' service overseas, again becoming associated with the New York Air Brake Company. In 1925 he joined the sales force of Johns-Manville as a special representative, with headquarters at Salt Lake City, Utah. He was appointed assistant manager of the Western division of the Transportation Department in December, 1927, and sales manager of the Western division in February, 1935.

Mr. Patten was born in Delavan, Ill. He was in the employ of the Missouri Pacific from 1909 until 1917, when he entered the service of Johns-Manville as sales representative, with headquarters at St. Louis and later at Omaha, Neb. He returned to St. Louis in October, 1936, as assistant sales manager of the Southwestern division.

◆

JOHN E. DIXON, vice-president of sales and engineering of the Lima Locomotive Works, Incorporated, has been elected president, with headquarters at New York. Mr. Dixon was born on September 11, 1877, at Milwaukee, Wis. After attending grade and high schools, he studied at the University of Wisconsin, from which he was graduated with the degree of B. S. in mechanical engineering in 1900. He then served his apprenticeship at the Brooks Works of the American Locomotive Company, Dunkirk, N. Y., and was later, successively, shop foreman, traveling engineer, draftsman, and general inspector. From 1905 to 1907 he was assistant to manager and manager of the Atlantic Equipment Company, and from 1907 to 1916, salesman and assistant manager of sales of the American Locomotive Company. He left the American Locomotive Company on January 1, 1916, to become vice-president of sales of the reorganized Lima Locomotive Works. In 1934 Mr. Dixon assumed also the duties of vice-president of engineering. In 1936 his responsibilities were again broadened when he took over the direction of the Shovel and Crane Division of the Lima Locomotive Works, Incorporated.

John E. Dixon

◆

WALLACE G. SMITH has been appointed sales representative of The Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. Mr. Smith was formerly with The Baldwin Locomotive Works and The Cramp Brass & Iron Foundries Co.

◆

FRANK W. DOYLE, member of the Waukesha Motor Company, Waukesha, Wis., sales staff for the past three years, has been appointed to the West Coast branch to represent both the engine and refrigeration divisions of the company.

◆

HERBERT K. WILLIAMS, assistant to the president and secretary of the Safety Car Heating & Lighting Co., New York, has been elected vice-president and J. H. Michaeli, assistant secretary and assistant treasurer has been elected secretary and assistant treasurer. Mr. Williams was born at Orange, N. J., in 1888. He was graduated from Orange High School in 1905, and immediately entered the employ of the Safety Car Heating & Lighting Co., as a clerk in the office of the mechanical engineer. After six years of service in the engineering and executive departments of the company, and at the time the axle-lighting system for railway passenger equipment cars was just coming into prominence, Mr. Williams was transferred to the factory and spent a large part of his time in the laboratory in a general study of the theory and design of axle lighting and equipment. In 1916 he was assigned to the New York sales district as representative. Two years later the export business of the company was consolidated in the department over which Mr. Williams was placed in charge, although at the same time he continued his connection with the New York sales district. He was appointed sales engineer in 1926 and in 1928 was appointed manager of the equipment department in charge of sales. In April, 1933, he was appointed assistant to the president and since June, 1936, Mr. Williams served also as secretary of the company.

Herbert K. Williams

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F. C. MEYER has been assigned to the Chicago office of the Armstrong Cork Company, Lancaster, Pa. Mr. Meyer will be in charge of transportation sales in that territory for the company's industrial division.

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ROBERT C. STANLEY has been elected a director of the United States Steel Corporation and a member of the finance committee succeeding Walter S. Gifford. W. A. Irvin, after 44 years of service with the corporation, has retired from the office of vice-chairman of the board, which position has been abolished. Mr. Irvin will continue as a member of the board of directors and finance committee.

The Pyle National Company, Chicago, has secured an exclusive license from the Burgess Battery Company, Madison, Wis., for the engineering, manufacturing and sale of its Multi-vent system of draftless ventilation for application to transportation equipment. Edward A. Sipp has returned to the Pyle-National Company as vice-president in charge of the Multi-vent division, after having spent the last three years in engineering and development work in connection with this system.

C. R. MacBride has been appointed manager of the engineering service department of the A. M. Byers Company, Pittsburgh, Pa., according to an announcement of M. J. Czarniecki, vice-president in charge of sales. Mr. MacBride has been transferred from the Boston, Mass., division sales office to assume his new duties. He was formerly in the service of the Edgewater Steel Company.

The Consolidated Car-Heating Company, Inc., Albany, N. Y., has elected new officers following the death of president Cornell S. Hawley. William S. Hammond, vice-president since 1912, and for 37 years connected with the company, is now president; John H. McElroy, secretary since 1917, and G. E. Oakley, for many years associated with the company, are vice-presidents; Frank M. Roos, purchasing agent and office manager, who has been with the company since 1910, is secretary and E. D. Ludlum, assistant treasurer, is treasurer.

George V. Christie, vice-president in charge of sales of Waldvogel Brothers, Inc., New York, has resigned to become representative of the Gustin-Bacon Manufacturing Company, Kansas City, Mo., with headquarters in New York.

Lyon McCandless has been appointed vice-president of the H. K. Porter Company, Pittsburgh, Pa., and B. D. Landes has been appointed general sales manager. Mr. McCandless is also vice-president of the Burgess Company, Inc., Beaver Falls, Pa. Mr. Landes was formerly manager of engineering service of the A. M. Byers Company, Pittsburgh.

Obituary

Ralph Brown, district sales manager of the Adams & Westlake Company, Chicago, died in that city on April 4 of coronary thrombosis. Mr. Brown was born in Chicago on December 2, 1874, and as a young man entered the service of A. B. Pullman. Later he formed his own company for the sale of railroad supplies, and after several years entered the employ of the Barney & Smith Car Company, where he became general sales manager. He became affiliated with the Curtain Supply Company on July 1, 1916, and with the Adams & Westlake Company when it took over the former company.

Ralph Brown

William H. Fogarty, Sr., assistant vice-president of the Johns-Manville Corporation, with headquarters at Chicago, died of a heart ailment on April 9, in Evanston, Ill.

E. L. Langworthy, who was associated with the Adams & Westlake Company for over 50 years, during 30 of which he was eastern manager, died at his home in Philadelphia, Pa., on April 11, at the age of 84 years.

Pliny Fisk, financial backer in the organization of the American Locomotive Company, died of cancer in New York on March 30, at the age of 78. The son of a partner of the Civil War financial house of Fisk & Hatch, Mr. Fisk carried on the family's business as Harvey Fisk & Sons. In 1901, after conferences with the owners of the Rhode Island Locomotive Works as to consolidating a group of small locomotive builders into one large concern, he financed the incorporation of the American Locomotive Works with a capital stock of $50,000,000 to take over Rhode Island, Cooke (both owned by International Power Company), Brooks, Manchester, Pittsburgh, Richmond, Schenectady and Dickson, with a consolidated output capacity, based on 1900 volume estimated at more than 44 per cent of the country's total. Mr. Fisk became a director and member of the executive committee of the new company and was instrumental in persuading Samuel R. Calloway, then president of the New York Central & Hudson River, to head the consolidated firm.

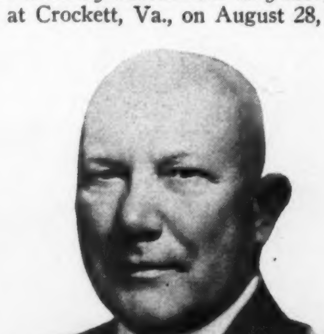
Personal Mention

General

G. C. Christy, whose appointment as general superintendent of equipment of the Illinois Central at Chicago, was reported in the April issue of the *Railway Mechanical Engineer,* was born at Holly Springs, Miss., in 1884, and entered railroad service as a helper in the paint shop of the Illinois Central at Water Valley, Miss., in 1898, while on vacation from school. Two years later he was transferred to the machine shop as an apprentice and, upon completion of his apprenticeship in March, 1904, he served until 1911 as a machinist and a foreman. In October of the latter year he was advanced to general foreman at Water Valley, and in December, 1914, was transferred to McComb, Miss. Mr. Christy was promoted to master mechanic of the Greenville and New Orleans division, with headquarters at Vicksburg, Miss., in July, 1917, and in 1926, his jurisdiction was extended to include the Vicksburg Route division. On November 1, 1929, he became superintendent of the car department, with headquarters at Chicago, and on November 1, 1937, was appointed superintendent of motive power.

G. C. Christy

Floyd R. Mays, whose promotion to general manager of the Illinois Central at Chicago, was announced in the April issue of the *Railway Mechanical Engineer,* was born at Crockett, Va., on August 28, 1879, and entered railway service at the age of fifteen as a machinist apprentice on the



Floyd R. Mays

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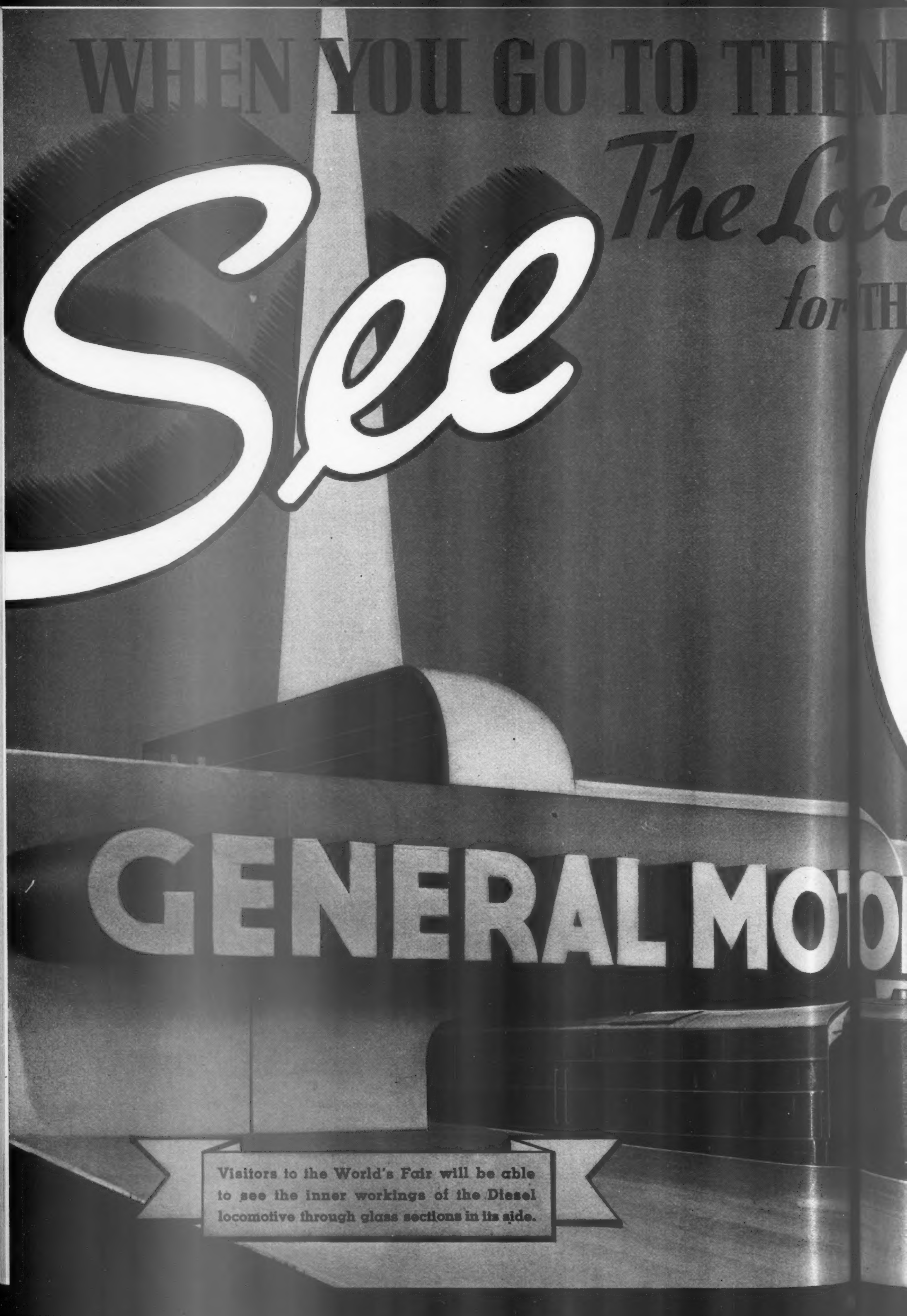

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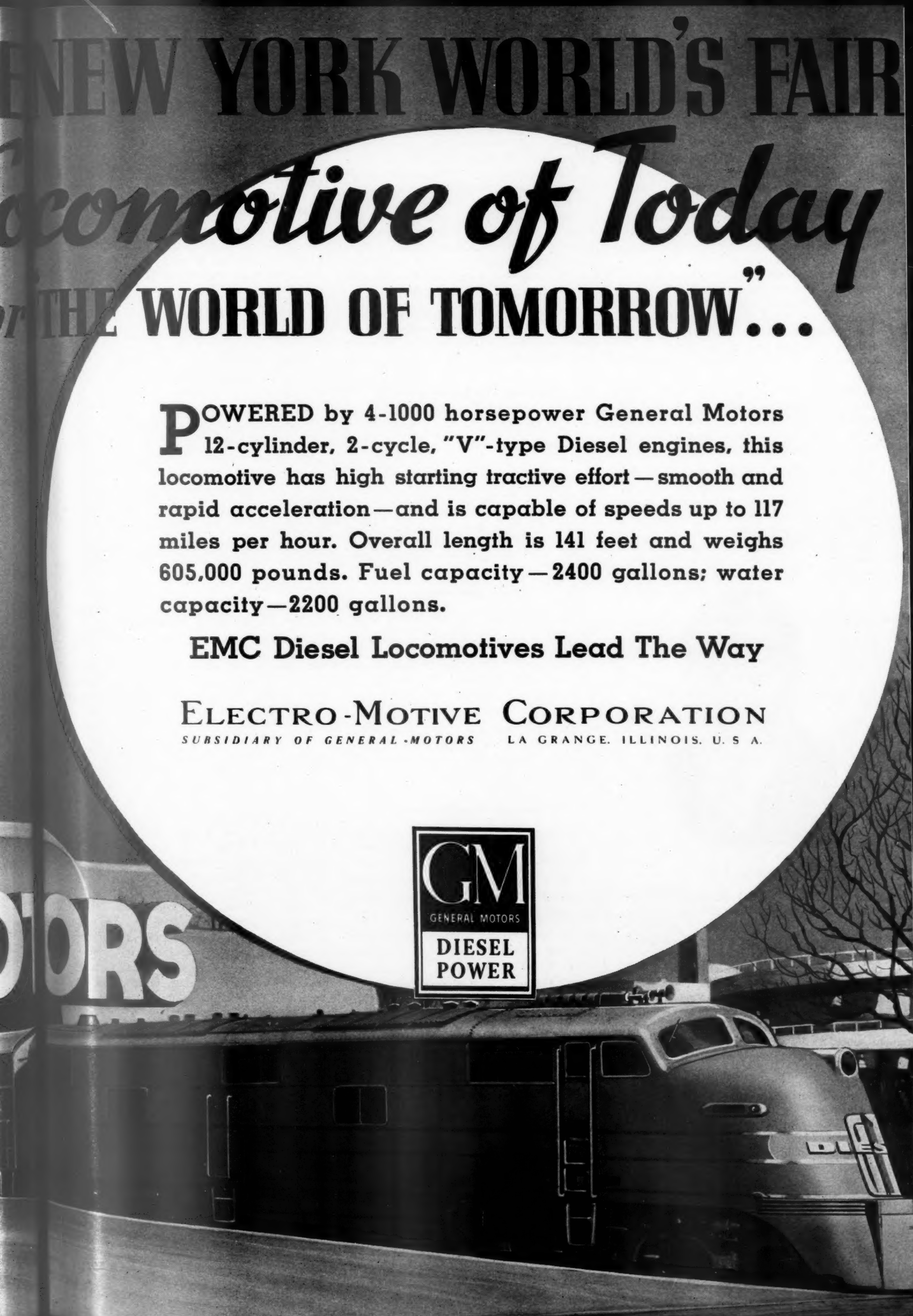
Visitors to the World's Fair will be able to see the inner workings of the Diesel locomotive through glass sections in its side.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"ocomotive of Today
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POWERED by 4-1000 horsepower General Motors 12-cylinder, 2-cycle, "V"-type Diesel engines, this locomotive has high starting tractive effort—smooth and rapid acceleration—and is capable of speeds up to 117 miles per hour. Overall length is 141 feet and weighs 605,000 pounds. Fuel capacity—2400 gallons; water capacity—2200 gallons.
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Norfolk & Western. Later, he was advanced to machinist and subsequently served in that capacity on the Southern at Salisbury, N. C., and Selma, Ala. On July 31, 1901, he became a machinist on the Yazoo & Mississippi Valley (now part of the Illinois Central) at Memphis, Tenn., and from October, 1901, to 1917, served successively as locomotive fireman, locomotive engineman, instructor on transportation rules, traveling engineer, assistant trainmaster, and trainmaster. On August 15, 1917, he was promoted to superintendent of the New Orleans division, with headquarters at Vicksburg, Miss., where he remained until April 1, 1923, when he was transferred to the Illinois division of the Illinois Central, with headquarters at Champaign, Ill. On January 1, 1926, Mr. Mays was advanced to general superintendent of the Y. & M. V., at Memphis, and on October 1, 1929, became general superintendent of motive power at Chicago. His title was later changed to general superintendent of equipment.

Raymond C. Cross, master mechanic of the New York Central at Collinwood, Ohio, has been appointed assistant superintendent of equipment Lines West of Buffalo, with headquarters at Cleveland, Ohio, replacing A. D. Bingman. Mr. Cross was born in Cleveland, Ohio, on November 7, 1886, and entered the service of the

Raymond C. Cross

New York Central as a machinist apprentice at the Collinwood locomotive shop on July 1, 1901. In June, 1911, he was promoted to gang foreman at the Collinwood enginehouse. In November, 1911, he resigned to go with the Chicago Great Western as an enginehouse foreman. Four years later he returned to the New York Central and served at various points as terminal foreman until April, 1930, when he was promoted to the position of assistant master mechanic. He was appointed master mechanic at Collinwood in March, 1934.

A. D. Bingman, assistant superintendent of equipment of the New York Central, Lines West of Buffalo, with headquarters at Cleveland, Ohio, has been appointed superintendent of equipment with the same headquarters, succeeding J. Chidley, who has retired. Mr. Bingman was born at Jersey Shore, Pa., on April 12, 1885, and entered the service of the New York Central as a machinist at Avis, Pa., in June, 1909. He was promoted to piecework inspector in December, 1911, and in January, 1917, was advanced to engine terminal foreman. Mr. Bingman was promoted to the position of master mechanic at Utica, N. Y., on February 1, 1928, and was later transferred, successively, to Harmon, N. Y., and Rensselaer, N. Y. In the fall of 1932, he was appointed assistant master mechanic at Harmon, N. Y.; two years later, master mechanic at Albany N. Y., and on May 1, 1938, became assistant superintendent of equipment, Lines West of Buffalo, with headquarters at Cleveland.

C. H. Eitel, chief draftsman of the Central of Georgia, with headquarters at Savannah, Ga., has been appointed engineer of tests, succeeding A. P. Wells, deceased.

Master Mechanics and Road Foremen

L. P. Whittingham has been appointed assistant master mechanic of the New York Central, with headquarters at Collinwood, Ohio, succeeding S. T. Kuhn.

Shannon T. Kuhn, assistant master mechanic of the New York Central at Collinwood, Ohio, has been promoted to master mechanic with the same headquarters succeeding R. C. Cross.

Car Department

C. A. Abbott, car foreman of the Canadian National with headquarters at Edmonton N., Alberta, has retired.

Frederick J. Irving has been appointed acting assistant foreman, car department, of the Canadian National at Campbellton, N. B.

Joseph H. Boucher has been appointed acting foreman, car department, of the Canadian National at Campbellton, N. B., succeeding R. Butler, retired.

Shop and Enginehouse

J. I. Brogdon, has been appointed assistant foreman, machine shop, of the Atlantic Coast Line at Waycross, Ga.

L. E. Atwell, has become foreman of locomotive repairs of the Atlantic Coast Line at Waycross, Ga.

J. R. Smith, has been appointed machine shop foreman of the Atlantic Coast Line at Montgomery, Ala.

W. S. Holman, enginehouse foreman of the Atlantic Coast Line at Waycross, Ga., has become foreman of locomotive repairs, with the same headquarters.

P. M. King, enginehouse foreman of the Atlantic Coast Line at Sanford, Fla., has been transferred to the position of enginehouse foreman at Montgomery, Fla.

R. O. Ward, a boilermaker in the employ of the Canadian National at Nutana, Sask., has been appointed acting boiler foreman, with headquarters at Melville, Sask.

Duncan Cameron has been appointed acting day locomotive foreman of the Canadian National at Dartmouth, N. S.

Grant McLean has been appointed acting night locomotive foreman of the Canadian National with headquarters at Halifax, N. S.

W. L. McGowan, gang foreman in the erecting shop of the Atlantic Coast Line at Tampa, Fla., has been transferred to Waycross, Ga., as general foreman.

F. M. Arrington, erecting shop foreman at the Emerson shops of the Atlantic Coast Line, Rocky Mount, N. C., has been appointed night enginehouse foreman, with headquarters at Rocky Mount.

Obituary

M. J. Hayes, master mechanic of the Toronto, Hamilton & Buffalo, with headquarters at Hamilton, Ont., died at Atlanta, Ga., on April 8 while en route home from Florida.

Arthur P. Wells, engineer of tests in the office of the superintendent of motive power of the Central of Georgia at Savannah, Ga., died in that city on March 27, after a long illness. Mr. Wells was born in Griffin, Ga., on December 15, 1872, and was a graduate in 1893 of the Georgia School of Technology. He became an apprentice in the shops of the Central of Georgia on October 23, 1893. He was later put in charge of the drafting department and was subsequently appointed engineer of tests.

Persifor Frazer Smith, Jr., former works manager of the Pennsylvania at Altoona, Pa., died at his home in Paoli, Pa., on April 5 after an illness of two months. Mr. Smith was born at West Chester, Pa., on August 1, 1870, and was graduated from Worralls Technical Academy, West Chester, Pa., in 1887. Following his graduation, he entered the service of the Pennsylvania as a special apprentice at the Altoona shops on October 24, 1887. He was appointed assistant road foreman of engines of the Pittsburgh division on February 1, 1892, and on August 1, 1893, was transferred in the same capacity to the "Fort Wayne Route" of the Pennsylvania, Lines West. Mr. Smith was promoted to assistant master mechanic of the Fort Wayne shops on February 1, 1895, and on November 10, 1896, was promoted to master mechanic in charge of the Crestline shops of the Toledo division. He was transferred to the Logansport, Ind., shops in the same capacity on January 1, 1900, to the Dennison, Ohio, shops on March 1, 1903, and to the Columbus, Ohio shops on August 1, 1906. On January 1, 1912, he was appointed superintendent of motive power of the Central system of the Pennsylvania, Lines West, and on January 1, 1917, became general superintendent motive power of the Pennsylvania, Lines West of Pittsburgh, with headquarters at Pittsburgh, Pa. On March 1, 1920, Mr. Smith was appointed works manager of the Pennsylvania in direct charge of the Altoona shops. On April 1, 1925, he was furloughed on account of ill health. On July 1, 1925, he became engineer of motive power on the staff of the chief of motive power and on December 1, 1931, was granted a leave of absence.